THE CHANGING FACE OF BANK CAPITAL STRUCTURE--1986-98: REGULATORS VS. MARKETS

BY

KASTURI P. RANGAN

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This work is dedicated to the memory of my late grandfather, R. K. Rangan (1918-1992), whose life continues to be an inspiration.

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Kasturi P. Rangan

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Chairman: Dr. Mark J. Flannery
Major Department: Finance, Insurance and Real Estate

Equity ratios in the banking industry have dramatically increased over the last decade and a half and are currently at the highest levels witnessed over the last seventy years. This study investigates the reasons behind this dramatic change in bank capital structure.

In this study, I show that over the sample period (1986-98) the banking industry has moved from a regulatory regime, wherein equity ratios of a large number of banks were constrained by capital standards, to a market regime wherein few banks seem to be constrained by capital regulation. Hence, contrary to popular belief, the introduction of the Basle standards had little effect on changes in bank equity ratios.

To investigate the reasons behind the observed increases in equity ratios, I develop a theoretical model that highlights the determinants of the optimal equity ratio for a value-maximizing bank in a market regime. Using the framework of this model, I derive both, theoretical propositions as well as empirically testable hypotheses that can explain the phenomenon under study.

The empirical analysis in this study tests the proposed hypotheses on a sample of banks that on average held over 75% of all banking assets. The sample period extends from 1986 through 1998. The results show that the change in regulatory stance on bank bailouts increased the sensitivity of risk on equity ratios, thereby increasing the amount of equity banks held, per unit risk. The results also provide support to the hypothesis that the investment opportunity set available to banks changed over the sample period. After controlling for other effects, it seems that this change in the investment opportunity set increased asset risk and thus increased equity ratios of banks. These two hypotheses (change in regulatory stance and change in investment opportunity set) together account for close to 60% of the observed changes in equity ratios.

CHAPTER 1
INTRODUCTION

Capital structure in the US banking industry has undergone dramatic changes over the last decade and a half. In 1986, the banking industry had an average book equity ratio of 6.8%.[1] This ratio has steadily risen over the years to 9.4% in 1998--an increase of 37%. Over the same period, market equity ratios have doubled from about 9.2% in 1986 to 19.2% in 1998. From a historical perspective, book equity ratios in banking today are the highest they have been in the last fifty years. To find a comparable figure to the current market equity ratio one has to go back even further to the boom years of the 1920's. In essence, as the numbers indicate, the banking industry has dramatically changed the way it finances its assets. The objective of this study is to explore the reasons behind this dramatic change in capital structure.

Since, the prevalent paradigm in the academic literature is that capital regulation significantly influences bank capital structure, the natural starting point of analysis is to investigate the impact of the introduction of the Basle standards in 1992. There is some evidence in the prior literature, that capital ratios increased due to the implementation of the Basle capital standards in 1992 (Wall and Peterson, 1995). However, as I show in this study, capital regulation does not provide a sufficient explanation for the increase. In 1986, 43% of the banks could be considered as constrained by the actual capital standards in place in 1986. If the Basle standards had been in place in 1986, only 26% of the banks would be considered constrained. Thus, if anything, the Basle standards seem to be less stringent than the capital

[1] Book equity ratio is defined as book value of equity divided by book value of assets. Market equity ratio is defined as market value of equity divided by market value of assets.

standards that they replaced. Even if the Basle standard did force some banks to raise their equity ratios, it still does not explain why capital ratios in the 1990's are much higher than what the regulators require them to maintain. For example in the 1980's, capital regulation required banks to hold primary capital greater than 5.5%, implying that banks on average had a cushion of a little over 1% over the regulatory requirement.[2] In the 1990's, subsequent to the adoption of the Basle capital standards, tier 1 capital (which is comparable to primary capital in the 80's) was mandated to be above 4% of risk weighted assets (RWA). The tier 1 capital maintained by banks averaged about 13.5% in the 1990's. Even if we use the higher requirement of 8% for the combined values of tier 1 and tier 2, banks in the 1990's seem to be maintaining a capital cushion larger than 5% of RWA. The implication of the numbers presented above is that value maximizing capital structure decision for banks is not constrained by regulatory restrictions. Moreover, it suggests that "market" forces (as opposed to capital regulation) have caused the observed increases in capital ratios.

In this study, I develop a model to highlight the determinants of a bank's choice of optimal debt ratio to explain the observed increase in capital ratios. The optimal debt ratio is determined by the tradeoff between two countervailing forces--the put option provided by the government on the liabilities of a bank and a bank's inherent charter value. The value of the put option arises from any underpricing in the explicit deposit insurance as well as the non-priced implicit assurances of the government to bail out a bank in the event of bankruptcy. Charter value arises from the future economic rents that would accrue to the bank if it were to continue to be solvent. The higher the value of the put option, the higher the incentive for the bank to increase its debt level. Conversely, higher the charter value for the bank, higher its incentive to reduce the debt level. The relative values of these two forces (the put option and

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[2] Primary capital constitutes common equity, loan loss reserves, some convertible debt and preferred stock. Hence the cushion is somewhat understated.

charter value) determines the optimal debt ratio for a bank. This tradeoff is also analyzed in models developed by Marcus (1984) and Keeley (1990). The model developed in this dissertation uses a more generic setup to highlight the intuition underlying the tradeoff. The framework of the model is then used to derive theoretical propositions as well as empirical hypotheses on possible reasons for the observed increases in equity ratios.

I propose three potential explanations for the observed increases in equity ratios in the banking industry. First, the regulatory stance on bank bailouts changed starting in the late 1980's. In the 1980's the government pursued a policy (known as the "too big to fail" policy) wherein it protected all bank liability holders from losses in the event of bankruptcy (O'Hara and Shaw, 1990). The government bailout of Continental Illinois in 1984 is often cited (e.g., Flannery and Sorescu, 1996) as a glaring example of this policy. However, starting in the late 1980's regulators have been more willing to back away from this policy and let the market absorb the losses of a failed bank. This represents a reduction in the value of the implicit insurance and hence would reduce the optimal debt level. While there has been a wealth of empirical evidence (e.g., Morgan and Stiroh, 1999) that show that yields on bank subordinated debt significantly increased following a change in the regulatory stance, the effect on equity ratios still remains to be empirically established.

A second reason that could explain the observed phenomenon pertains to the changes in the risk of the activities of the banking industry. The nature of the banking services has dramatically changed over the last two decades. The banking industry has lost much of its investment grade short-term financing business to the commercial paper market. Financial innovation has created a secondary market for loans and product deregulation has expanded the scope of the banking services. Traditional banking activity has become commoditized driving down the profits from these activities. This has led to specialization by banks in specific asset classes (Kimball, 1997). The increase in concentration of specific asset classes

on banks' balance sheets provides evidence of this trend.[3] All of these changes in banking activity suggest that the investment opportunity set available to banks has changed. If one believes that the opportunity set available to banks today is comprised of more risky projects, then as I show in proposition 2 of this paper, the optimal response for banks would be to reduce their debt ratio.

Increases in charter value also would increase the optimal equity ratio that banks would hold. This is a standard result in the literature (e.g. Keeley, 1990) which I also derive as proposition 3. The question is whether charter value increased in the 1990's. The literature has primarily associated the operation of a bank in an industry where entry is restricted as the main source of charter value. With geographic deregulation the general consensus is that banking services have become more contestable and thus competitive. Hence, an increase in charter value on that dimension is hard to argue. However, if we define charter value more broadly as the sources of all economic rents that would accrue to the bank, then there are several of these sources that could have increased. As an example, increased concentration within asset classes to take advantage of economies of scale could be a source of charter value that has increased in the 1990's leading to an increase in equity ratios.

The above hypotheses are tested on a sample of banks that on average held 75% of all banking assets. The sample period extends from 1986 through 1998. Results of the empirical analysis show that the change in regulatory stance increased the sensitivity of equity ratios to risk, thereby increasing the amount of equity banks held, per unit risk. The results also provide support to the hypothesis that the investment opportunity set available to banks changed over the sample period. After controlling for other effects, it seems that this change in the investment opportunity set increased asset risk and thus increased equity ratios

[3] Figure 2-9 shows the increase in concentration of assets within a bank's balance sheet over the sample period (1986-98).

of banks. These two hypotheses seem to explain close to 50% of the observed increases in equity ratios.

The banking industry is regulated across the world because the safety and soundness of this industry is critical to ensure growth in the economy. Regulators in many countries including the US, use capital requirements as an instrument for regulation. As a result, trends in equity ratios are keenly monitored as measures of the overall health of the industry. Thus, understanding reasons behind the recently witnessed increases in bank equity ratios is important.

In this context, this study makes two important contributions to the literature. First, it brings to light a phenomenon that has received little attention in the academic literature. It also establishes that changes in capital regulation can not explain the increases in equity ratios. The movement of equity ratios from a regulatory to a market regime, suggests that market forces have become important in determining equity ratios. This paper provides a framework for understanding as well as investigating how these market forces are changing the capital structure of banks. The empirical analyses also provide support to the explanations proposed in this paper.

Secondly, the paper calls to question the relevance of the present capital standards as a measure of bank health. The paper shows that capital standards have become increasingly less binding over the sample period. So, if we measure the health of the banking industry as adherence to capital standards, then we can conclude that the banking industry has become a lot safer over the sample period. But, if the capital standards in place do not accurately reflect the risks of the environment that banks operate in today, then measuring the health of the industry using these standards might be meaningless. In recent times, there has been significant concern expressed in the popular press about the health of the banking industry. Whether these concerns are justified is an empirical question.

The rest of the dissertation is organized as follows. In the next chapter, I empirically establish the puzzle that this research is trying to investigate. Chapter 3 contains a model that explains the tradeoffs inherent in a bank's choice of optimal debt ratio. Using this model, in I propose three possible explanations for the observed phenomenon. Chapter 4 outlines the empirical design while Chapter 5 presents the results of the empirical analyses. Finally, Chapter 6 discusses the contributions of this study and concludes.

CHAPTER 2
ESTABLISHING THE PUZZLE

Data

Under the Federal Reserve's 'Regulation Y', all bank holding companies (BHCs) with consolidated assets greater than $150 million are required to report their consolidated financial statement through the "FR Y-9C" form. The Federal Reserve Bank of Chicago has made this data available on its web site for all quarters starting in the second quarter of 1986. I use this data as my primary source for balance sheet data on BHCs. My sample period extends from the second quarter in 1986 to the fourth quarter of 1998.

For the analysis in this chapter I select the 1000 largest BHCs every quarter, yielding an unusually large sample of 51,000 bank quarters for analysis. The largest 1000 BHCs represent on average 98% of the assets in the banking industry. Hence, the analysis in this paper can be considered as representative of the whole industry without bias.

As the banking industry is highly skewed on the dimension of asset size, I sub-classify my bank sample into four categories - Mega-banks, large banks, medium banks and small banks. Mega-banks are banks with asset ranks 1 through 20. Similarly, large banks, medium banks and small banks are banks with asset size ranks 21-100, 101-500 and 501-1000, respectively.[4]

The source for stock market data is the CRSP database. As the Y-9 data do not contain an identifier that would allow for automated matching, the market data and the Y-9

[4] I have experimented with other asset size classifications. While, the trends are qualitatively similar for the other classification schemes, this classification seems to best segregate the sample for some analyses that are explained in detail later.

data had to be manually matched. In my sample, I have 520 BHCs across all quarters for which I was able to make a satisfactory match.[5]

Trends in bank equity ratios

Figure B-1 shows the evolution of market and book equity ratios of banks over the entire sample period (1986-98). The average book equity ratio in 1986 was 6.8%. By the end of 1998, this ratio had climbed up to 9.3% - an increase of 37%. The rise in market equity ratios has been more dramatic. In 1986, bank market equity ratios averaged 9.4%. By the end of 1998 this ratio had more than doubled to 19.7%. As the banking industry is highly skewed in terms of asset sizes of banks, it might very well be the case that the trends observed in figure B-1 are primarily driven by the small banks which hold an insignificant amount of the industry's assets. To check for this possibility, I show in figure B-2 (panels A through D) book and market equity ratios for the different size classes. It is evident from the graphs that the trend of increasing equity ratios is uniform across size classes. In fact the rate of increase of equity ratios (both book and market) is the highest for the mega-banks, suggesting that if we were to plot the value-weighted equity ratios of banks in figure B-1, the increases would be more dramatic.[6]

While the period of study in this paper is 1986-98, it is interesting to look at recent equity ratios in relation to the historical trends in bank equity ratios. In figure B-3, I plot average annual book and market equity ratios of banks starting in 1893. The source of the data for this graph in the pre-sample period (i.e. 1893-1985) is from Saunders and Wilson (1996). From the graph, it is easy to see that book equity ratios today are the highest over the

[5] I thank Mark Flannery for providing me an initial sample of 321 BHCs that had cusips, on which to build my final sample of 520 BHCs.

[6] Book equity ratios for the mega-banks increased from 5.2% in 1986 to 7.6% in 1998 (an increase of 46%), while the market equity ratios increased from 4.8% in 1986 to 19.2% (an increase of 300%) by 1998.

last fifty years. In terms of market equity ratios, one has to go back to the 1920's to find the levels that we are witnessing currently. The last time we witnessed such a dramatic increase in both book and market equity ratios were in the boom years of the 1920's - a scary thought!

While the rise in equity ratios in the banking industry seem to be dramatic, it is important to ascertain whether this phenomenon was specific to the banking industry or was it an economy wide trend of the 1990's. Hence, I plot in figure B-4, the market and book equity ratios for all industrial firms in COMPUSTAT.[7] Book equity ratios for industrial firms remained pretty steady at about 45% over the sample period. Market equity ratios seem to have slightly increased from about 50% in 1986 to 57% in 1998. On the other hand, banks increased their book equity ratios and their market equity ratios have also increased more steeply than the industrial firms (see figure B-1), suggesting that this trend of increasing equity ratios is specific to the banking industry.[8]

In summary, the trend of increasing equity ratios in the banking industry, while uniform within the industry, seems to be distinct from the trend witnessed in other industries. This suggests that in looking for reasons to explain the observed trend, we need to look at factors that are intrinsic to the banking industry. An obvious candidate is capital regulation.

Impact of Capital Regulation on Bank equity ratios

Capital Regulation

Capital regulation is generally motivated along two dimensions. The first is that the provision of the safety net (deposit insurance and other implicit guarantees from the government) provides perverse incentives for equity holders of banks to increase leverage

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[7] To calculate these ratios, I exclude firms with SIC codes in the range 4000-5000 (Utilities) and 6000-7000 (Financial firms).

[8] I have also looked at trends in equity ratios for different industries using four digit SIC codes. None of the industries seem to exhibit similar trends as observed in the banking industry.

and take on more risk. Hence capital regulation reduces the exposure of the government, the lender of last resort, to the moral hazard risk that the provision of the safety net introduces. The second rationale underlying capital regulation is that regulators can control the probability of default of a bank by mandating capital ratios.[9] Regulators have incentive to keep the probability of default low for banks as a failure of one bank can entail systemic effects on the rest of the banking industry and consequently on the economy as a whole.

Despite the provision of deposit insurance since the 1930's there were no formal capital requirements until 1981.[10] Prior to that bank capital was regulated on an ad hoc basis and was primarily at the discretion of bank supervisors. Starting in December of 1981 formal book-value capital requirements were introduced.[11] Banks were required to hold at least 5 percent of their assets in primary capital and 5.5 percent of total capital (primary plus secondary capital). Primary capital included common equity, loan loss reserves, some convertible debt and preferred stock, while secondary capital included subordinated debt and the remaining preferred stock. In 1985 the requirements were raised to 5.5 and 6 percent for primary and total capital respectively.

The next change in capital regulation came with the signing of the Basle accord in 1988. The main innovation in the Basle accord was to attempt to make capital requirements a function of the risk of a bank's activities (i.e. both on-balance sheet assets and off-balance sheet activities).[12] Banks had now to maintain capital ratios above a minimum percentage of risk weighted assets (RWA). To calculate RWA, all assets on and off the balance sheet were

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[9] These rationales have been extensively debated in the literature (Furlong and Keeley (1987, 1989,1991), Koehn & Santomero (1980)).

[10] The FDIC was incorporated through the Banking Act of 1933.

[11] For a complete chronology of capital regulatory changes in the US since 1979, refer to Berger, et al. (1995a).

[12] Strictly speaking, the primary focus of the Basle standards of 1988 was to incorporate (only) credit risk into capital requirements.

assigned a risk weight of 0, 20, 50 or 100 percent, depending upon the credit risk group to which the obligor belongs and the type of financial instrument. The Basle accord stipulated that banks hold tier 1 capital in excess of 4 percent, as well as the combination of tier 1 and tier 2 capital in excess of 8 percent. Equity and some preferred stock, net of good will, counted towards tier 1 capital while subordinated debt, remaining preferred stock and loan loss reserves (limited to 1.25% of RWA) were the main components of tier 2 capital.[13]

The US phased in the adoption of Basle standards. Starting December, 1990 banks were required to hold a minimum of 3.625 percent in tier 1 capital and a minimum of 7.25 percent of total capital (tier 1 + tier 2). In December of 1992 these requirements were raised to 4 and 8 percent for tier1 and total capital respectively. In addition, BHCs were required to hold at least 3 percent of unweighted assets (i.e. total assets on the balance sheet) in tier 1 capital.

Market or Regulatory regime?

In determining the factors that have caused bank equity ratios to rise over the last 15 years, it is first important to determine the influence of capital regulation on observed capital ratios. I define a bank to be in a regulatory regime, if the optimal equity ratio that maximizes the value of the bank is less than the regulatory minimum. If the optimal equity ratio is greater than the regulatory minimum, then the bank is considered to be in a market regime.[14] As an example, if the regulatory minimum is 6 percent, and for bank A the equity ratio that maximizes its value is 5 percent then it has no choice but to hold at least 6 percent of its assets in equity. In essence, the capital structure decision for the bank is constrained by the

[13] For a complete list of components of tier 1 and tier 2 capital, please refer to the "Instructions for preparation of form FR Y-9C" published by the Board of Governors of the Federal Reserve System.

[14] The definitions for market and regulatory regimes that I use are similar to the ones that Berger et al. (1995b) use.

capital regulation in place and hence it is considered to be in a regulatory regime. Now consider bank B, for whom 8 percent is the value maximizing equity ratio. This bank is unconstrained by the regulatory minimum and hence will hold 8 percent in equity. Consequently, bank B is considered to be in a market regime.

In figure B-5, I plot for all banks in my sample the regulatory measures of capital that banks held for the period 1986-1998. Notice that for the period 1986-1991 the pre-Basle standards (primary capital and primary + secondary capital) are used and for the period 1992-1998, the Basle standards are used (tier1 and tier1+tier2).[15] The overall trend that is observed is an increase in the capital ratios that banks held through the period. In 1986, the average cushion that banks held over the minimum total capital (primary + secondary capital) was 1.1 percent. By 1998, this cushion had risen to 5.6 percent. A capital cushion of 5.6 percent over the minimum total capital ratio (tier 1 + tier 2) of 8 percent represents 70 percent (5.6/8.0) excess capital. This strongly suggests that the average bank in the 1990's was in a market regime, while in the 1980's it was in a regulatory regime.

As the distribution of bank equity ratios tend to be bimodal, looking at average ratios can be sometimes misleading, especially when determining whether the banking industry was predominantly in a regulatory regime or in a market regime. Hence, in Table A-1, I show the percentage of banks that can be considered to be in a regulatory regime each year. Panel B shows the percentages for all banks in the sample while panel A provides the same information for each size class. The first column shows the percentage of banks that were below the regulatory standard.[16] As falling below capital standards can be costly, banks that

[15] Though the Basle standards were phased in starting December 1990, I use 1992 as the first year of the Basle standard period. The reason is that for the year 1991, banks with asset sizes of less than one billion dollars had to report only an abbreviated Schedule HC-I for their RWA on their Y-9C forms. Hence, their RWA had to be estimated. Starting in March 1992, all BHCs reported detailed components of RWA.

[16] A bank that fails any of the regulatory minimums - primary or total capital in the pre-Basle period and tier 1, tier1 + tier2 or the leverage requirement in the Basle period - are considered to be below the regulatory standard.

are constrained by the capital standard would choose to maintain a small capital cushion. Hence in column 2, I calculate the percentage of banks that were above the regulatory minimum but had less than 1.5 percent of capital cushion.[17] These banks are also assumed to be in a regulatory regime.[18] Column 3 presents the sum of the columns 1 and 2. This represents the total number of banks that can be considered to be in a regulatory regime.

The first pattern that emerges from this table is that over the sample period there seems to be a distinct movement of the banking industry from a regulatory regime to a market regime. Figure B-6, panel A presents a bar chart of the data in panel B of table A-1. In 1986, close to 43% of the banks were in a regulatory regime. By the end of 1998 this number had fallen to an insignificant 4.4%. The graph also shows that while there has been a steady decline over the sample period, there was a significant decrease in the percentage from 1991(28.5%) to 1992(9.3%). This period coincides with the adoption of the Basle standards in the US. This raises the possibility that the trend observed in the bar-chart might be a function of the capital standard in place. To check for this possibility, I perform the same analysis using each of the capital standards (pre-Basle and Basle standards) for the entire sample period. Similar to the bar chart in panel A (figure B-6), panels B and C show bar charts for banks in a regulatory regime using the pre-Basle and Basle standards respectively. We see that the patterns in these graphs are very similar to the one observed in panel A, suggesting that the movement to a market regime was independent of the regulatory standard in place. One other notable observation is that the Basle standards seem to be less stringent than the pre-Basle standards. For example in 1986, if the Basle standards were in place only

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[17] I have also experimented by using 1 and 2 percent as minimum capital cushions. They yield qualitatively similar trends.

[18] Of course there might be some banks for whom the optimal equity ratio lies within 1.5 percent of the regulatory minimum.

26 percent of the banks would be considered to be in a regulatory regime when compared with 43 percent using the pre-Basle standards.

The impact of the introduction of the Basle standards

There have been a few studies in the literature (e.g. Wall and Peterson, 1995) that have argued that the introduction of Basle standards forced banks to raise their equity ratios. While figure B-6 suggests otherwise, the issue warrants further investigation. If the Basle standards caused an increase in the equity ratios of banks, then we should expect the Basle standards to be binding in the pre-Basle period. To investigate this issue adherence to Basle capital standards needs to be measured in the pre-Basle period. The problem is that prior to 1992 (pre-Basle period) the Y-9C data does not have enough detail to construct RWA and thus the regulatory ratios of tier 1 and tier 2 capital. In fact RWA were not even reported on the Y-9C forms prior to 1996. However there is enough detail in the data from 1992 to 1996 to construct the RWA accurately. Hence, RWA for the pre-Basle period need to be estimated.

To this end, I first run a regression of the form -

$$RWA_{i,t} = a0_i + \Sigma_{j=1 \text{ to } n} \{bj_i(\text{Weight of asset category } j)_{i,t}\} + e_{i,t} \qquad (2\text{-}1)$$

for each bank i and quarter t for the period 1992Q1-1998Q4.[19] I then use the estimated coefficients from equation (2-1) to predict RWA for the pre-Basle period (1986Q3-1991Q4).[20]

Figure B-7 shows the estimated tier 1, tier 1 + tier 2 and leverage ratios for all banks over the entire sample period. It seems evident that none of the ratios were binding for the average bank at any time.[21] Even in 1986, the capital cushion averaged 3.5 percent. Further, it

[19] I use 7 asset categories for this estimation -- Asset ranks 1-20, 20-50, 50-100, 100-250, 250-500, 500-750 and 750-1000.

[20] The R-squareds for these regressions ranged from 0.87-0.98.

[21] Using medians for the analysis in the place of means, yields qualitatively similar results.

seems that the trend of increase in the capital ratios had started well before the implementation of the Basle standards in 1992. Panel C in figure 6 shows a similar trend of decrease in the percentage of banks that were under a regulatory regime, well before the implementation of the Basle standards. Figure B-8 (panels A through D) show the capital ratios for each asset size class. In these graphs we see that there are different periods of rapid increase in capital ratios for different asset classes. For example, large banks increased their capital ratios significantly in the period 1989-1994, while the mega-banks increased their capital ratios from 1986 to 1993, after which they held steadily to their newly acquired capital ratios. This suggests that the reasons for increase in equity ratios might be different for different asset classes.

Two conclusions can be drawn from the analysis in this section. Firstly, the banking industry has moved from a regulatory regime to a market regime in the sample period under study. Secondly, the movement to a market regime seems to be independent of the regulatory standard in place. The Basle standards seem to have been less binding than the old capital standards that they replaced. Jones and King (1995) also provide evidence to the same effect. They show that banks with high risk of insolvency during the period 1984-89, would have been considered well capitalized with respect to the Basle standards.[22] Wall and Peterson (1995) provide a more direct analysis of whether the implementation of the Basle standard increased equity ratios. They conclude that "...most BHCs felt little market or no regulatory pressure to increase their leverage ratios..." They find that only BHCs that were subject to regulatory orders significantly increased their equity ratios in the 1990-92 period. In summary, the overall trend of increase in equity ratios for the banking industry seems to be driven by factors other than the Basle standards.

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[22] The focus of their paper was to assess the effectiveness of FDICIA, that uses the Basle standards as a benchmark, as a tool for 'prompt corrective action'.

The first step towards investigating the causes of increased bank equity ratios is the understanding of the determinants of bank capital structure. This would provide a framework for investigating how potential changes in the determinants of bank capital structure could have caused the observed increases in bank equity ratios.

CHAPTER 3
A MODEL OF BANK CAPITAL STRUCTURE

In a perfect Modigliani and Miller world the capital structure of a bank doesn't matter. But as one starts relaxing the assumptions and introduces capital market frictions, theories of an optimal capital structure emerge. Much of these theories are based on the tax effects of debt, informational asymmetries, agency costs and the costs of bankruptcy. These are theories that are generic to all firms – banks as well as non-banks. Therefore while motivating empirical tests for bank capital structure one can appeal to the above mentioned capital market frictions to motivate the choice.

The point of departure of bank capital structure theory is in the recognition that the banking industry is regulated. A unique feature of this industry is that there is a federal safety net. The government provides explicit (deposit insurance) as well as implicit insurance on the liabilities of the bank to ensure the safety and soundness of the banking industry. The provision of this safety net introduces an extra level of agency problems between the bank shareholders and the regulators.

Merton (1977) shows that deposit insurance provided to banks can be viewed as a put option on the value of the assets with a strike price equal to the insured part of the liabilities.[23] This put option is owned by the shareholders of the bank. Hence, shareholder value maximizing banks have incentives to increase the leverage (the strike price of the put) as well as the risk of the bank. Consequently, a manager of a bank, acting in the interests of the shareholders would like to operate with no equity (at the limit). In the presence of capital

[23] While Merton (1977) uses this framework for deposit insurance, the same intuition applies to other forms of implicit insurances by the government.

requirements, the manager would want to operate at a level as close to the capital requirement as possible.

Even in the days prior to the formal enforcement of capital requirements (1981) banks did not operate with 100% debt in their capital structure. In fact, they had lower leverage ratios than what was observed in the 1980's (see figure 1). The reason that has been proposed in the literature is that the excessive risk taking that is encouraged by the provision of deposit insurance (as well as other implicit guarantees) has a countervailing force – charter value (Keeley (1990)). Charter value can be simply defined as the 'going concern' value of the bank. In other words, it is the extra value that would accrue to the shareholders if the bank were to continue to operate when compared with the value of instantaneous liquidation of the assets of the bank.

The tradeoff between these two countervailing forces - the put option and the charter value - determines the optimal capital structure for a bank. I formalize this intuition in the next section through an illustrative model. In subsequent sections, I use the model to derive empirical implications for possible reasons of the observed increase in equity ratios during the 1990's.

An Illustrative Model

Consider a model with two time periods. A bank needs to raise a dollar for investment at time period 0. It can invest the raised dollar in any of the projects it its investment opportunity set - J. The set J contains projects (denoted by j) that generate cash flows x_j in time period 1. The cash flows of project j are distributed normally with mean μ and standard deviation σ_j,[24] i.e.

[24] I assume for simplicity that all the projects contained in J have the same mean μ. Allowing for different means just adds complexity to the model without providing any added intuition. Also note that I have not assumed any relation between the expected return μ and risk σ, unlike other models in the literature (for e.g. Koehn and Santomero (1980)).

$\tilde{x}_j \sim N(\mu, \sigma_j)$

Let $f(x_j ; \mu,\sigma_j)$ denote the probability density function and $F(x_j ; \mu,\sigma_j)$ denote the cumulative density function of x_j.

The bank wishes to decide on the optimal mix of debt (D) and equity (1-D) to finance its investment. The debt D includes both the explicitly insured liabilities (e.g., demand deposits) as well as the implicitly insured liabilities (e.g., subordinated debt). Most models of bank capital structure in the literature focus only on the explicitly insured liabilities. Though the inclusion of implicitly insured liabilities does not change the underlying intuition of the tradeoffs associated with optimal capital structure, the distinction becomes important for the analysis in the next section on possible reasons for observed increases in equity ratios.

The bank also needs to decide on the project from J that would maximize the value of its equity holders. As in Marcus (1984) and Keeley (1990), I also assume that the bank is exogeneously endowed with a charter value C, the rents of which it realizes only in the event that it remains solvent in time period 1.

The amount raised as debt by the bank is essentially risk free due to the explicit and implicit insurance provided by the government on the bank's liabilities.[25] If the risk free rate is assumed to be zero then the expected gross return on the equity raised is

$$R_E = \frac{1}{1-D}\left[\left(\int_D^{\infty}(x_j - D + C)\, f(x_j;\mu,\sigma_j)dx_j\right) - (1-D)\right] \qquad 3\text{-}1)$$

Notice that the equity holders receive cash flows only in the states that the bank is solvent, i.e., when $x_j > D$. Equation (3-1) can be rewritten as

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[25] Even if the explicit insurance, such as deposit insurance is priced, the implicit insurance is not. Hence, the total insurance is underpriced making the interest paid by the bank on the debt less than what it would have to pay in the absence of the insurance, creating value in the put option. For simplicity, I assume that the insurance provided by the government is not priced.

$$R_E = \frac{1}{1-D}\left[\left(\int_{-\infty}^{\infty}(x_j - D + C)\, f(x_j;\mu,\sigma_j)dx_j\right) - (1-D)\right] +$$

$$\frac{1}{1-D}\left[\int_{-\infty}^{D}(D - x_j)\, f(x_j;\mu,\sigma_j)dx_j\right] - \frac{1}{1-D}\left[\int_{-\infty}^{D}(C)\, f(x_j;\mu,\sigma_j)dx_j\right] \quad (3\text{-}2)$$

$$= R_{NB} + PI - CV \quad (3.3)$$

The first term, R_{NB} , represents the return on equity for a bank that has zero probability of bankruptcy.[26] The second term, PI, is the put option that equity holders own due to the provision of government insurance. The third term, CV, represents the expected loss in charter value that equity holders will bear in the states of bankruptcy.

It is apparent from equation (3-3) that the optimal structure is determined by the tradeoff between the value gain that the put option provides and the loss in charter value in the states were bankruptcy is encountered. The components of the tradeoff, PI and CV are a function of both D as well as f(.). Under the assumptions of this model, since the probability of bankruptcy is a function of σ_j and D only (μ is a constant), the maximization problem reduces to one of choosing D and σ_j. Hence, the maximization problem is[27]

$$\underset{D,\,\sigma_j}{\text{Max.}} \quad R_E\,(D,\ \sigma_j;\mu, C)$$

Corner Solutions

(1) If CV > PI for all possible values of D, then the bank will choose to finance the entire investment with equity. This corresponds to the case when the bank has extremely high charter value and hence will not risk bankruptcy.

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[26] Of course, this is impossible with a normal distribution unless the bank is all equity financed. I rewrite equation (2) in this form, just to highlight the tradeoffs associated with choosing the optimal capital structure.

[27] Strictly speaking, the maximization problem should include the constraint $0 \le D \le 1$. However, I assume that the constraint is not binding, which would be the case if $\mu > 1$, i.e. the bank is investing in a positive NPV project and if the charter value is high enough so as to not yield a corner solution.

(2) If C = 0, then $\partial R_E / \partial D > 0$ for all D, hence the bank will want to finance the entire investment with debt. This represents the case when the bank has no charter value, and hence the bank in trying to maximize the value of the put option will hold a hundred percent of its liabilities in debt.

Interior Solution

To find the interior solution, D^* and σ^*, $\partial R_E / \partial D$ and $\partial R_E / \partial \sigma$ need to be computed and equated to zero. The derivative of R_E with respect to D, upon simplification yields -

$$\partial R_E / \partial D = R_E - C\, f(.) - (1-F(.)) = 0$$

$$\Rightarrow R_E (D^*, .) = C\, f(D^*) + (1-F(D^*)) \qquad 3\text{-}4)$$

Equation (3-4) implies that the optimal debt level, D^*, is chosen when the marginal gain of having an extra dollar of debt, $R_E (D^*, .)$, just equals the marginal cost. The marginal cost has two components. The first one, $C\, f(D^*)$, is the expected loss in charter value due to the increase in the marginal dollar of debt. The second component, $1-F(D^*)$, is the expected value of the increased debt payment in the states that the bank is solvent due to an increase in the debt ratio. Notice that the corner solutions can be derived by setting $C = \infty$ and 0 in equation (3-4).

Similarly, solving for $\partial R_E / \partial \sigma$ yields:

$$\partial R_E / \partial \sigma_j = (D - \mu)C + \sigma_j^2 = 0$$

$$\Rightarrow \sigma_j^{*2} = (\mu - D)C \qquad 3\text{-}5)$$

Equations (3-4) and (3-5) specify the interior solution for the bank's maximization problem. The bank can choose numerous combinations of D^* and σ^* that would satisfy equations (3-4) and (3-5). This is so because the tradeoff between the put option and the expected loss in charter value requires the bank to choose an optimal probability of default

that would maximize the return of its equity holders. Since the optimal probability of default can be obtained through different combinations of D^* and σ^*, the interior solution is actually a set of D^* and σ^* combinations. Hence, in investigating possible reasons for the observed increases in equity ratios, the effect on optimal risk also needs to be taken into consideration.

Why have equity ratios increased in the 1990's?

The illustrative model presented in the previous section provides a good starting point for analyzing possible explanations for the observed increases in equity ratios. The optimal debt level chosen by a bank is a function of the implicit insurance provided by the government, the possible choices of asset risk available its investment opportunity set and its inherent charter value. Any changes in these determinants would alter the optimal debt level. In the next three sub-sections, I derive propositions that predict how changes in these determinants will affect the optimal debt level. I also provide arguments on why we might expect changes in the determinants of the optimal debt.

Change in Regulatory Stance

In the early 1980's, regulators implicitly protected all liabilities of banks from credit losses (O'Hara and Shaw, 1990). This was more explicit for the larger banks under the "too big to fail" (TBTF) policy. The most glaring example of this policy was the bailout of Continental Illinois bank in 1984. However, starting in the late 1980's, regulators have been more willing to share the burden of bank losses with the markets.[28] There is ample evidence (Avery et al. (1988), Flannery and Sorescu (1996), Jagtiani et al. (1999), Morgan and Stiroh (1999)) that in the 1990's yields on bank subordinate debt are correlated with the risks of the

[28] See Flannery and Sorescu (1996) for a brief chronology of bank failures in the 1980's where the regulators moved from a stance of observing all losses of the failing bank to one where they let the market participants share the losses of the failed bank.

bank.[29] This empirical evidence suggests that the change in regulatory policy has shifted the onus of monitoring bank risk considerably to the market.

The implication of the increased risk sensitivity of uninsured debt is that effective leverage increases due to the increased debt payments that need to be made. In the model presented in the previous section, debt D was assumed to be risk free and since the risk free rate was 0, the promised payment at time period 1 was also D. Now consider that the face value of debt is D_0. Since debt is risk sensitive, the promised payment at time period 1 will be

$$D = R\, D_0 \; ; \; R = (1+r)$$

where r is the promised interest rate (above the risk free rate). It is important to note that if r accurately reflects the risk of the debt then there is no value in the put option PI.[30] This would push the optimal solution to a corner, where a bank with positive charter value will finance the investment entirely with equity.

The case of interest here is when R>1 and less than the value in the absence of all implicit assurances of a bailout. A reduction in the implicit guarantee corresponds to an increase in R.[31] The effect of this action on the optimal debt and asset risk levels chosen by the bank is given by proposition 1.

Proposition 1*:A reduction in the implicit guarantees by the government of a bailout, ceteris paribus, leads to a reduction of the optimal debt level and (or) asset risk chosen by the bank, i.e.* $\partial D_0^* / \partial R < 0 ; \partial \sigma^* / \partial R < 0$

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[29] In the 1980's Avery et al. (1988) fail to find any correlation of subordinate debt yields to the underlying risks of the banks, suggesting a lack of market discipline in the 1980's.

[30] Of course, there will be still value in PI due to mispricing in the deposit insurance. However, it is assumed that the deposit insurance is accurately priced so as to focus on the effect on the reduction in the implicit guarantees of a bailout.

[31] I assume that R is exogenous. Hence, R can be thought of as the public's expectation of the probability of a bailout by the government, that is independent of the bank's choice of default probability. Assuming R to be endogenous (as a function of default probability chosen by the bank) will yield the same result.

Proof:

$$D = R\,D_0 \tag{3-6}$$

$$\Rightarrow \partial D_0^* / \partial R = -D / R^2 < 0$$

From equation (3-5), σ^* can be rewritten as

$$\sigma^{*2} = (\mu - D_0 R)C \tag{3-7}$$

$$\Rightarrow \partial \sigma^* / \partial R = -D_0 C / 2\sigma < 0$$

QED

The intuition underlying proposition 1 is simple. The reduction in the implicit guarantees of a bailout, *ceteris paribus,* reduces the value of the put option PI. Hence, the optimal response of a bank trying to protect its charter value is to raise its equity level and (or) reduce the risk of the assets in place. Both of these actions reduce the probability of bankruptcy and thus an increased chance of protection of charter value.

Another implication of the increased risk sensitivity of uninsured debt financing is that agency costs between the uninsured debt-holders and equity-holders become important. Though this effect is not modeled in this paper, it has implications for the empirical analysis. An introduction of agency costs between debt and equity holders, provides incentive for riskier banks to hold more equity so as to provide a credible signal against committing moral hazard on the debt holders. This reduces the overall cost of financing.

Changes in the Investment Opportunity Set

Banks are in the business of providing liquidity services and credit to agents in the economy. While it may be argued that these underlying rationales have remained the same (Kashyap, et. al, 1998), the manifestations of the provision of these services have undergone a sea of change. Over the last two decades, there has been a gradual shift by the large, high-grade borrowers from banks to the commercial paper market for their short-term financing needs. This shift has been all the more dramatic in the 1990's due to the bull market (Boyd

and Gertler (1994) and Saidenberg and Strahan (1999)).[32] As a result, banks are providing loans only to the smaller, lower-grade borrowers making their commercial and industrial loan portfolio riskier.

Banks today routinely sell their illiquid loans through securitization. While they have started specializing in the origination of these loans and innovated in a manner to enhance liquidity of these loans through securitization, they still retain the riskiest portion of these loans on their balance sheet.[33]

With the relaxation of product restrictions in the banking industry, we are observing bank holding companies providing investment banking and insurance services along with their commercial banking operations. The increase in the ratio of income generated from non-interest sources, from 13% to 40% between 1986 to 1998, exemplifies the dramatic shift in the nature of bank services provided.

The changes in the nature and form of banking services provided are manifestations of the changing environment in which banks are operating in today. This suggests that the investment opportunity set available to banks has changed. The question is how does a change in the investment opportunity set affect a bank's capital structure decision.

In the model, the bank's opportunity set was represented by J. J contained projects that produced cash flows x_j. These cash flows were distributed normally with mean μ and standard deviation σ_j. A change in the investment opportunity set can be thought of as a structural shift - s - in the standard deviations of the available projects. In other words, J_N, the new investment opportunity set contains projects with cash flows that are normally

[32] However, banks still provide guarantees on the commercial paper issues of these investment grade issuers.

[33] Though, the Basle standards require that the bank hold capital against the entire amount of the securitized asset, banks have found a way around the requirement through 'regulatory capital arbitrage'. See Jones (2000) for a description of the methods used by banks to perform regulatory capital arbitrage.

distributed with mean μ and standard deviation $s\sigma_j$. The effect of this change in the investment opportunity set on the optimal debt level is given by proposition 2.

Proposition 2*: Except for banks with very low charter value, a shift in the investment opportunity set that leads to a set of projects with higher risk, results in the reduction of the optimal debt level;* $\partial D_0^*/\partial s < 0$

Proof:

$$\partial D_0^*/\partial s = (\partial D_0^*/\partial \sigma)(\partial \sigma/\partial s) = (\partial D_0^*/\partial \sigma)(s) \tag{3-8}$$

Totally differentiating equation (3-4) yields -

$$(\partial F/\partial s - C(\partial f/\partial \sigma))\partial \sigma = (C(\partial f/\partial D^*) - f)\partial D^*$$

$$\Rightarrow \partial D^*/\partial \sigma = -\frac{\mu - D}{\sigma} - \frac{1}{(\mu - D)/\sigma - \sigma/C} \tag{3-9}$$

Substituting into equation (3-8)

$$\Rightarrow \partial D^*/\partial s = \left(-\frac{\mu - D}{\sigma} - \frac{1}{(\mu - D)/\sigma - \sigma/C}\right)(s)$$

Hence, $\partial D^*/\partial s < 0$ if $C > \dfrac{\mu - D}{1 - (\mu - D)^2/\sigma^2}$

An increase in asset risk, *ceteris paribus*, increases the probability of bankruptcy. Hence, the optimal response of the bank is to decrease its debt level so as to reduce the probability of bankruptcy and thus its charter value. This relationship gets reversed for banks with extremely low charter value as they prefer to adopt a 'go for broke' strategy by increasing their debt level. This strategy is profitable to the low charter value banks as the benefit of having higher debt level and higher risk is far greater than the cost of losing their small charter value in the event of bankruptcy. This dichotomous relationship between charter value and risk is also observed in Marcus' (1984) model where he uses an option framework to analyze optimal capital structure for banks.

Changes in Charter Value

The effect of changes in charter value on the optimal debt level is given by proposition 3.

Proposition 3*:Ceteris paribus, an increase in charter value results in a decrease in the optimal debt level chosen;* $\partial D^* / \partial C < 0$

Proof:

Taking the derivative of equation (3-4) with respect to C yields-

$$\partial D^* / \partial C = \frac{f - \partial R_E / \partial C}{f - C\,\partial f / \partial D} = \frac{f - (1-F)/(1-D)}{f - (\mu - D)C/\sigma^2} < 0$$

QED

This is a standard result that is found in both Keeley (1990) and Marcus (1984). An increase in charter value increases the potential cost for a bank in risking bankruptcy. Hence, the optimal response of the bank is to increase its equity so as to decrease the probability of bankruptcy. The question is whether during the sample period under study, equity ratios of banks increased due to increases in the charter value of banks.

Charter value can be broadly defined as the present value of future rents that would accrue to the bank if it continued to operate. Hence, the measurement of charter value requires the identification of the different sources of future rents. In Keeley's (1990) paper, the main source of charter value for a bank stemmed from the operation in an industry where entry was regulated and hence restricted. He argued that bank equity ratios declined in the 1980's, as there was an increase in competition causing a decline in the charter value of banks. With more deregulation and increased competition in the 1990's, it is hard to argue that increases in Keeley's charter value could have caused the observed increases in equity ratios.

However, there are other possible sources of charter value. As an example, consider - efficiency.[34] The more efficient a bank, the higher its potential to earn rents in the future, and consequently the higher its charter value. Stiroh (1999) provides evidence that bank holding companies in the 1990's have had higher productivity and better scale economies, which has translated to improved performance.[35] Relationships established with borrowers over time are also a source of economic rents. These relationships reduce the cost of loan origination and hence make lending more profitable (Berger and Udell (1995); Petersen and Rajan (1995)). Demsetz, et al. (1996) distinguish these sources of charter value as 'bank-related', from Keeley's charter value which they term as 'market related'.

One other source of charter value that is often ignored in the literature is the increased concentration of banks in specific asset classes. This has become increasingly important in the 1990's. As an example, the Herfindahl index of mortgage servicers has almost doubled in the 1990's.[36] In 1996, the largest twenty-five players in this market controlled 75% of the assets in dollar value. The reason specialization in asset classes has become important is that the nature of the services provided in these classes has changed over time. The provision of these services requires expertise and scale economies and hence investments in acquiring these skills and increased asset concentration can potentially be a source of future rents. As figure B-9 indicates, during the period 1986-1998, banks have significantly increased the concentration of the asset classes that they operate in, suggesting that scale economies favour more concentrated asset composition.

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[34] Efficiency can be measured on several dimensions such as cost, profit, revenue, scale, etc. For an extensive survey of the efficiency literature in banking, see Berger and Mester (1997).

[35] The question is complicated by the fact that there is potentially an inverse relationship between market power and efficiency (Quiet life hypothesis). Berger and Hannan (1998) provide evidence of the same.

[36] The Herfindahl Index in the mortgage servicing asset class rose from 0.018 in 1989 to 0.033 in 1996 (Stiroh, 1999).

In summary, the sources of charter value are varied and have probably changed over time. Hence in the measurement of charter value for incorporation in an empirical model to explain capital ratios, the set of sources that have traditionally been used in the literature need to be expanded. A more complete identification of the sources allows a more accurate measurement of changes in charter value over time.

As a final note, it is important to view these hypotheses as independent and not mutually exclusive. All of the proposed explanations could have contributed to the observed equity ratios. In the empirical analysis that follows, I test whether these proposed explanations contributed to an increase in equity ratios. In addition I also estimate the relative contributions of the propositions to the observed increases in equity ratios.

CHAPTER 4
EMPIRICAL DESIGN

The objective of this study is to investigate the reasons behind the observed increases in equity ratios in the banking industry. The theoretical model, presented in the prior chapter, provides a framework for testing the cross-sectional determinants of bank equity ratios. Chapter 3 also outlines potential explanations in the form of empirically testable hypotheses for the observed increases in equity ratios. These hypotheses, however, seek to explain a time series trend in equity ratios by testing structural shifts in the cross-sectional determinants of equity ratios. Hence, the empirical analysis needs to first test for structural shifts in the determinants of banks equity ratios, and as a second step estimate the impact of these structural shifts on the observed increases in equity ratios.

The desired equity ratio maintained by a bank is a function of the risk of the assets it holds and its charter value. Asset risk is derived from the composition of assets in a bank's portfolio. The amount of asset risk a bank chooses is also a function of the inherent charter value that it possesses. As the theoretical model indicates that a bank chooses its optimal equity ratio and asset risk simultaneously, the empirical model can be represented as follows:

Equity ratio = f(Asset risk, Charter value) (4-1)

Asset risk = f(Equity ratio, Charter value, Weight of asset category 1, Weight of asset category 2,…, Weight of asset category N) (4-2)

(4-1) and (4-2) represent a simultaneous equation system that specifies the cross-sectional determinants of equity ratios (and asset risk). The empirical implication of Proposition I is that a change in the regulatory stance on bank bailouts in the late 1980's could have caused banks to hold more equity in their capital structure. Similarly, the empirical

implication of proposition II is that a change in the investment opportunity set for banks from the 1980's to the 1990's caused an increase in the observed equity ratios. The testing of these hypotheses is a two step procedure. First, it needs to be tested whether changes in the investment opportunity set and regulatory stance, caused a structural shift in the determinants of equity ratios and portfolio risk. As a second step, the impact of these structural shifts on the rise in equity ratios needs to be measured.

Testing for a Structural Shift

To explain the tests for a structural shift in the determinants of equity ratios and asset risk for banks, it is useful to make some simplifying assumptions. Assume that banks hold only two kinds of assets in their portfolio -- x and y. Also assume that data for a sample of banks is available for two time periods (t=0 and t=1). Under these simplifying assumptions, the model given by (4-1) and (4-2) can be rewritten as follows:

$$E_{i,t} = \alpha_0 + \alpha_1 R_{i,t} + \alpha_2 d * R_{i,t} + \Gamma A_{i,t} + \varepsilon_{i,t} \qquad (4\text{-}3)$$

$$R_{i,t} = \beta_0 + \beta_1 E_{i,t} + \beta_2 W^{x}_{i,t} + \beta_3 d * W^{x}_{i,t} + \beta_4 W^{y}_{i,t} + \beta_5 d * W^{y}_{i,t} + \Lambda B_{i,t} + \delta_{i,t} \qquad (4\text{-}4)$$

where:

$E_{i,t}$: Equity ratio of bank i in time t

$R_{i,t}$: Measure of asset risk of bank i in time t

$W^{x}_{i,t}$: Weight of asset x at time t in the portfolio of bank i

$W^{y}_{i,t}$: Weight of asset y at time t in the portfolio of bank i

$A_{i,t}$: A vector of other independent factors, including charter value, that determine equity ratios

$B_{i,t}$: A vector of other independent factors, including charter value, that determine asset risk

d : A dummy variable that takes the value of 1 if t=1[37].

$\alpha, \beta, \Gamma, \Lambda$: Coefficients

Hypothesis 1: Change in regulatory stance (H1)

$H_0: \alpha_2 \leq 0 \quad H_1: \alpha_2 > 0$

The rejection of H_0 would indicate that banks held a higher amount of equity per unit risk at t = 1 when compared with t = 0. Proposition 1 shows that a reduction in the conjectural guarantees on the uninsured liabilities of a bank would make the amount of equity it holds more sensitive to its asset risk. In other words, the optimal equity per unit risk would rise. Hence, if t=0 and t=1 correspond to the time periods prior and subsequent to the change in regulatory stance on bank bailouts, then the rejection of H_0 would indicate that the change in regulatory stance caused banks to hold higher amounts of equity per unit risk.

Hypothesis 2 : Change in the investment opportunity set (H2)

$H_0 : [\beta_3, \beta_5] = 0 \quad H_1 : [\beta_3, \beta_5] \neq 0$

Hypothesis 2 (H2) is a joint test for whether β_3 and β_5 are different from 0. A rejection of H_0 would indicate that there has been a structural shift in the determinants of risk stemming from the portfolio of assets maintained by banks. As an example, consider a bank that at t=0 held 30% of its portfolio of assets in asset x. The contribution of asset x to the overall risk of the bank is measured by β_2. If asset x became more risky, as a consequence of a change in the investment opportunity set, then the contribution of asset x to the overall asset risk will increase. Hence, β_3 will be greater than 0. Since H_0 jointly tests for the possibility

[37] The use of a dummy in this empirical model is to indicate regimes across which hypotheses need to be tested. However, in the simplified structure of the empirical model presented here, the use of the dummy is superfluous as there are only two time periods (d=t=1). As a result, in the ensuing discussion presented in this section, the new regime, i.e. when the dummy takes the value of 1, is also referred to as time period 1.

that the contributions of asset classes to the overall risk has changed over time, a rejection of H_0 would indicate that the investment opportunity set available for banks has changed.

Hypothesis 2 tests only whether the investment opportunity set has changed. It is silent on the effect of the change in investment opportunity set on portfolio risk. As only an increase in risk can contribute to an increase in equity ratios, the next step is to test whether the change in investment opportunity set contributed to an increase in risk.

Hypothesis 3: Contribution of changed investment opportunity set on asset risk (H3)

$H_0 : R(\beta_3, \beta_5 ; W^x_{t=0}, W^y_{t=0}) \leq 0 ; \quad H_1 : R(\beta_3, \beta_5 ; W^x_{t=0}, W^y_{t=0}) > 0$

This hypothesis tests whether the change in investment opportunity set (the change in β's from time period t=0 to t=1), *ceteris paribus,* caused an increase in the amount of asset risk. β_3 and β_5 measure the change in investment opportunity set. Hence, $R(\beta_3, \beta_5 ; W^x_{t=0}, W^y_{t=0})$ is a measure of the change in asset risk due to a change in the investment opportunity set. By using the asset weights at t=0, the effect of portfolio reorganization is purged and the pure effect of the change in the investment opportunity set is measured. A rejection of H_0 would indicate that the change in investment opportunity set increased portfolio risk. With $\alpha_i > 0$, this increase in portfolio risk will, *ceteris paribus*, increase equity ratios.

Assessing the Impact on Bank equity ratios

Hypotheses 1 and 2 test whether there has been a structural shift in the cross-sectional determinants of equity ratios and asset risk. However, they are silent on the impact of these structural changes on the observed increases in equity ratios. For instance, hypothesis 2 tests for whether the investment opportunity set changed and hypothesis 3 tests for whether this change resulted in an investment opportunity set with riskier projects. The hypotheses are set up as tests under *ceteris paribus* conditions. Their net effect on the observed increase in

equity ratios, however has to be calculated by taking into account any endogenous actions that banks can undertake to offset the changes in their investment opportunity set. The measurement of this effect is complicated by the fact that banks choose their optimal asset risk and equity ratio simultaneously. Hence, a change in the investment opportunity set will affect the optimal equity ratio as well as the asset risk chosen.[38]

To illustrate the point, consider the earlier (hypothesis 2) example of a bank that held 30% of its assets in asset category x. If the contribution of asset x to the overall risk increases, i.e. $\beta_3 > 0$, then the initial effect is to increase the bank's portfolio risk. In response, the bank has two choices. It can either increase its equity or reduce the weight of asset x in its portfolio thereby reducing its portfolio risk. Hence the resultant (observed) increase in equity ratio, is the net effect of both these actions. Similarly, banks can respond to a change in the regulatory stance (hypothesis 1) by changing their portfolio composition. Consequently, the estimation of the effects of the structural changes in explaining the rise in equity ratios needs to account for any endogenous portfolio reorganization that banks might undertake.

This intuition can be formalized as follows. Equations (4-3) and (4-4) suggest that the equity ratio maintained by a bank is a function of α's, the coefficients on the cross sectional determinants of equity ratios, β's, the contributions of asset categories to the overall risk of the bank, and W's, the weights of the different asset categories in the bank's portfolio. As the weights of the different asset categories are endogenously determined by the α's and β's, the equity ratio E of a bank can be represented as[39]:

$$E(\alpha,\beta, W(\alpha,\beta))$$

Taking the first order approximation of the total differential yields:

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[38] The same reasoning applies to the effect of a change in regulatory stance on bank bailouts.

[39] Equity is also a function of the charter value and other independent variables as given by (4-3), however, for expositional simplicity I concentrate only on α and β as they are the variables of interest here. Also note that W represents a vector of all asset category weights.

$$dE = \frac{\partial E}{\partial \alpha} d\alpha + \frac{\partial E}{\partial \beta} d\beta + \frac{\partial^2 E}{\partial \alpha \partial \beta} d\alpha d\beta + \frac{\partial E}{\partial W} dW$$

Equation (4-5) shows that the change in equity ratios is explained by the combination of two effects - the impact of the exogenous changes in the regulatory stance ($d\alpha$) and in the investment opportunity set ($d\beta$), and the bank's endogenous asset allocation reponse (dW).[40]

Rewriting (4-5) yields:

$$dE = \frac{\partial E}{\partial \alpha} d\alpha + \frac{\partial E}{\partial \beta} d\beta + \frac{\partial^2 E}{\partial \alpha \partial \beta} d\alpha d\beta + \frac{\partial E}{\partial W}\left[\frac{\partial W}{\partial \alpha} d\alpha + \frac{\partial^2 W}{\partial \alpha \partial \beta} d\alpha d\beta + \frac{\partial W}{\partial \beta} d\beta\right] \quad (4\text{-}6)$$

Equation (4-6) shows that the observed increases in equity ratios can be partitioned into the following four effects [41]:

E1.The effect of a pure change in the regulatory stance on bank bailouts -- $\frac{\partial E}{\partial \alpha} d\alpha$

E2.The effect of a pure change in the investment opportunity set -- $\frac{\partial E}{\partial \beta} d\beta$

E3. The cross product effect of a pure change in investment opportunity set and a pure change in the regulatory stance on bank bailouts -- $\frac{\partial^2 E}{\partial \alpha \partial \beta} d\alpha d\beta$; and

E4.The effect of portfolio reorganization as a response to the above three effects -- $\frac{\partial E}{\partial W}\left[\frac{\partial W}{\partial \alpha} d\alpha + \frac{\partial^2 W}{\partial \alpha \partial \beta} d\alpha d\beta + \frac{\partial W}{\partial \beta} d\beta\right]$

The interpretation of effects E1 and E2 are straightforward. They measure under *ceteris paribus* conditions the portion of the observed increases in equity ratios that can be attributed to the change in regulatory stance and the change in investment opportunity set respectively. Effect E3, the cross product effect, partially relaxes the *ceteris paribus*

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[41] Using the notations in (4-3) and (4-4), (4-6) can also be represented as:
$dE = E_{i,1} - E_{i,0} = \{\alpha_2 (\beta_2 W^x_{i,0} + \beta_4 W^y_{i,0})\} + \{\alpha_1 (\beta_3 W^x_{i,0} + \beta_5 W^y_{i,0})\} + \{[(W^x_{i,1} - W^x_{i,0})(\alpha_2 \beta_2 + \alpha_1 \beta_3 + \alpha_2 \beta_3)] + [(W^y_{i,1} - W^y_{i,0})(\alpha_2 \beta_4 + \alpha_1 \beta_5 + \alpha_2 \beta_5)]\}$

conditions of E1 and E2. It measures the increase in equity that can be attributed when both α and β change simultaneously and in the absence of any endogenous portfolio reorganization effects. Effect E4, is simply the amount of equity change that can be attributed to any portfolio reorganization that the bank endogenously undertakes as a response to effects E1 through E3.

Equation (4-6) also highlights the difficulty in apportioning the observed changes in equity ratios accurately to the two hypotheses (change in regulatory stance and change in the investment opportunity set). Changes in the investment opportunity set affect asset risk, which in turn affects the optimal equity ratio. In addition, the change in regulatory stance changes the coefficient of asset risk (α). E1 and E2 measure the effect of these two changes (in regulatory stance and investment opportunity set, respectively) with the assumption imposed by *ceteris paribus* conditions, that they are the only change that occurred. However, both of these changes (can) occur simultaneously. The effect of simultaneous changes in the absence of any portfolio reorganization is measured by E3.

The response of the bank to these changes in the form of portfolio reorganization also cannot be apportioned unambiguously to the two hypotheses. This is due to the fact that we observe only the resultant response in the form of dW to both these changes. As we do not observe (or estimate) changes in the portfolio due to the individual exogenous changes $(\frac{\partial W}{\partial \alpha}, \frac{\partial W}{\partial \beta})$ we cannot apportion the portfolio reorganization effects to the two changes.

In summary, the sum of E1 through E4 will provide an estimate of how much of the observed increase in equity ratios that can be attributed to both these hypotheses jointly. While it is possible to get a sense of the relative contributions of the two hypotheses by looking at the individual pure effects (E1 and E2), it is impossible to completely decompose the two effects.

CHAPTER 5
EMPIRICAL ANALYSIS

The sample used for the empirical analysis includes the 100 largest BHCs (large and mega banks) in terms of book asset values, selected every quarter over the period 1986Q2-1998Q4. Of these 100, I could identify on average, 86 publicly traded banks each quarter. These publicly traded banks held on average more than 75% of the total banking industry assets. As the sample covers such a high percentage of the banking industry's assets, the results of the empirical analysis can be considered representative of the trends of the banking industry from an economic significance standpoint.

As a starting point for the analysis it is useful to look at how the balance sheets of the banks changed over the sample period. Table A-2 provides snapshots of the average bank at the start of the sample period - 1986 - and at the end of the sample period -1998.[42] It is immediately apparent that the composition of assets for the average bank in 1998 was dramatically (and statistically) different from the average bank in 1986. With the exception of agricultural loans, every asset category experienced a statistically significant change over the sample period. The big gainers include intangible assets that grew by more than 150%, and off-balance sheet activities that more than tripled between 1986 and 1998. Similarly real estate loans also constituted a much higher percentage of total assets in 1998 (31.31%) when compare with 1986 (17.61%). However there were other asset categories, like C&I loans and Bad loans (non-accruing + past due loans) that experienced declines as a percentage of total assets from 1986 to 1998. The loan portfolio on bank balance sheets in 1998 however, as the

[42] Second quarter data is used to compute the numbers.

herfindahl number indicates, seems to have been significantly more concentrated when compared with 1986.

These changes on the asset side of the balance sheet seem to have contributed to increases in asset risk and equity ratios. Overall asset risk has almost tripled from 1986 to 1998 while equity ratios have more than doubled over the same time period. While the snapshot of bank balance sheets provided in Table A-2 clearly indicates dramatic changes, the investigation of the reasons behind the same and the establishment of causality between changes on the asset side of the balance sheet and the increase in equity ratios, requires the implementation of the empirical design outlined in the previous chapter.

Empirical Model

(4-3) and (4-4) in chapter 4 represent the empirical model under the simplifying assumption that a bank has only two asset categories in its portfolio. Relaxing this assumption yields:

$$E_{i,t} = \alpha_0 + \alpha_1 R_{i,t} + \alpha_2 d^* R_{i,t} + \Gamma A_{i,t} + \varepsilon_{i,t} \quad (5\text{-}1)$$

$$R_{i,t} = \beta_0 + \beta_1 E_{i,t} + \Sigma_{j=2,n} \{ \beta_j W^j_{i,t} + \gamma_j d^* W^j_{i,t} \} + \Lambda B_{i,t} + \delta_{i,t} \quad (5\text{-}2)$$

Following (5-1) and (5-2), and substituting the actual variables used in the analysis, the specification that is used to perform the empirical analysis is as follows:

$$MKTRAT_{i,t} = \alpha_0 + \alpha_1 STDEVA_{i,t} + \alpha_2 d^* STDEVA_{i,t} + \Gamma_3 HMB_{i,t} + \Gamma_4 ROA_{i,t} + \Gamma_5 LNTA_{i,t} + \Gamma_6 REGP_{i,t} + \varepsilon_{i,t} \quad (5\text{-}3)$$

$$STDEVA_{i,t} = \beta_0 + \beta_1 MKTRAT_{i,t} + \Sigma_{j=2,n} \{ \beta_j W^j_{i,t} + \gamma_j d^* W^j_{i,t} \} + \Lambda_2 HMB_{i,t} + \Lambda_3 REGP_{i,t} + \delta_{i,t} \quad (5\text{-}4)$$

MKTRAT is the ratio of the market value of equity to the market value of assets (book value of liabilities + market value of equity). STDEVA, the standard deviation of assets, is used as a measure of the risk of banking assets. It is computed as the product of

standard deviation of daily equity returns, calculated over a quarter, and the market equity ratio. MKTRAT and STDEVA are jointly estimated in a simultaneous equation framework using a three stage least square procedure. To control for fixed effects, a dummy for each bank is included in the MKTRAT equation. In addition, as the system is run as a pooled-cross-sectional-time-series regression, year dummies are also included in the specification to control for time series effects.

HMB is a dummy variable that takes the value of 1 if a BHC's market to book ratio is in the top 25 percent of all BHCs in the sample that year. This dummy variable is used as a proxy for charter value. A number of papers (Keeley, 1990, for example) use Tobin's Q (market to book ratio of assets) as a measure of charter value. Though I include Tobin's Q as an alternate measure of charter value in robustness checks (explained in greater detail in a separate section), I use HMB in my primary regressions for two reasons. Firstly, since Tobin's Q has the market value of equity in the numerator and so does the dependent variable MKTRAT there could be spurious correlation that could show up in the coefficient of the Tobin's Q variable. Secondly, if Tobin's Q measures charter value with error then the specification will have an 'error in variables' problem, the result of which would be biased coefficients.[43] The use of HMB as an alternate specification circumvents both these problems. As HMB is a dummy variable indicating banks with market to book ratio of assets in the upper twenty fifth percentile, the coefficient that will be estimated will be a measure of how much extra capital banks in the upper quartile maintain when compared with the rest of the sample.

In the empirical specification presented in (5-3) and (5-4) the coefficient of HMB is expected to be positive in the MKTRAT equation and negative in the STDEVA equation.

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[43] See Madala and Nimalendran (1996) for a detailed explanation of the EIV (errors in variables) problem in financial models.

Berger (1995) among others has shown that equity ratios and earnings are positively related. Banks that have high earnings, *ceteris paribus*, are able to retain higher amounts of earnings, which show up as increased equity ratios. To control for this correlation, I include the (quarterly) lag value of ROA, the ratio of net operating income to total assets, as an explanatory variable in the MKTRAT equation.

REGP is a dummy that takes the value of 1 if a bank is below the regulatory capital standard. Since banks that are below the capital standard are constrained by regulatory action, their equity ratios (and/or asset risk) may not reflect optimal equilibrium behavior. To control for this possibility, REGP is included in the MKTRAT and STDEVA equations.

Banks with higher information asymmetry with regards to their asset composition (and risks) might be forced by the markets to have higher equity ratios. As size has often been used in the literature (see Keeley, 1990, as an example) as a proxy for information asymmetry, LNTA, the natural logarithm of total assets is used in this study. Since smaller banks are expected to have higher information asymmetry, LNTA is expected to have a negative sign on the MKTRAT equation.

Apart from MKTRAT and HMB, the STDEVA equation also includes the weights (measured as a ratio of total assets) of all balance sheet asset categories.[44] To avoid perfect multi-collinearity, the ratio of cash to total assets is dropped from the specification. In addition, a measure of the concentration of loan categories - HERFLN- and the ratio of the notional value of off-balance sheet activities to total assets - OBSTA are also included.

The simultaneous equation system given by (5-3) and (5-4) is estimated as a pooled cross-sectional regression using a three stage least square procedure. Annual observations on banks are used for the estimation. I use the end of third quarter each year, as the annual data

[44] These asset categories are SECTA, FFREPTA, TRADETA, RLOANTA, CILNTA, AGLNTA, OTHLNTA, INTANTA, BADTA, OREOTA and MISCTA. The definition of these variables are provided in Table B-1.

point. This leads to a total of 1113 annual bank observations. The variables -MKTRAT and STDEVA- utilize stock market information at the end of the third quarter. Since it is unclear whether market participants at the end of the third quarter had access to third quarter balance sheet data, I use second quarter data for the balance sheet variables. In effect, all balance sheet asset ratios, OBSTA and ROA have one quarter lagged values. Using contemporaneous balance sheet variables yields qualitatively similar results.

Results

Hypotheses 1 and 2 test for a structural change in the cross sectional determinants of equity ratios and asset risk. This calls for partitioning the data into two regimes over which the structural change can be tested. As hypothesis 1 tests whether the change in regulatory stance increased the sensitivity of risk on equity ratios, the date on which the change occurred would be an ideal place to partition the sample. Although formal regulatory action through FDICIA effectively removed all *de facto* insurance on uninsured liabilities (Morgan & Stiroh, 1999) only in 1991, studies on market discipline using subordinated debt data (e.g. Flannery & Sorescu, 1996) find that the change in regulatory stance had taken effect by year end 1989. Hence, the ideal cutoff date for partition of the sample to test for structural shifts is unclear.

As a result, I perform tests for structural change using both 1989 and 1992 as the starting years of the new regime. Table A-3 presents the results for all the banks in the sample, Regression I uses 1989 as the start date of the new regime while regression II uses 1992 as the start date of the new regime. In regression III, I delete the overlap period - 1989 through 1991 - and run the same analysis to test the robustness of the results. In addition, as regression III omits the years (1990 and 1991) during which the banking industry was facing significant difficulties, it allows the testing of whether this period (1990-91) has a significant effect on the results.

The general pattern across all regressions is that banks that are riskier (STDEVA), smaller (LNTA), better performing (ROA) and having a high charter value (HMB) maintain higher equity ratios. Similarly banks with higher equity ratios and lower charter values tend to have higher asset risk. As these are the relationships predicted by the theoretical model, the regressions seem to be well specified. Now, I turn to the testing of the hypotheses laid out in the empirical design.

Hypothesis 1: Change in regulatory stance (H1)

The coefficient of the dummy interaction variable, d*STDEVA in equation (5-3), measures the change in sensitivity of the equity ratio to asset risk. Hypothesis 1 tests whether this coefficient is zero. Regression I of table A-3 uses 1989 as the starting year for time period 1. The coefficient on d*STDEVA is 10.075 and is statistically significant at the 1% level suggesting that the change in regulatory stance increased the sensitivity of risk on equity ratios in the period 1989-98. In contrast, the coefficient on d*STDEVA is -0.877 (and not statistically significant) in regression II which uses 1992 as the start of time period 1. However, the coefficient on STDEVA is 20.01 and is statistically significant. This suggests that the change in regulatory stance had occurred prior to 1992 and the intervening period of 1989-1991 is part of the new regime of regulatory attitude towards bank bailouts. This conclusion is further validated in regression III, where the intervening period of 1989-91 is dropped. Here again, the coefficient of d*STDEVA is 10.146 and is statistically significant at the 10% level.

Hypothesis 2: Change in the investment opportunity set (H2)

Testing for a change in the investment opportunity set involves the joint test that all coefficients on the asset weight variables in the new regime (e.g. d*BADTA) are different from zero. Table A-3 shows for each regression the chi-square statistic of this test. In all three

regressions the chi-square statistic is statistically significant at the 1% level, suggesting that the investment opportunity set in period 1 differed significantly from the investment opportunity set in period 0.

It can be argued that the test of the change in investment opportunity set should not include asset categories BADTA (past due and non-accruing loans) and OREOTA as banks do not have direct (or active) control of these categories while making their portfolio composition decisions. Further, these asset categories are backward looking in that they are a result of portfolio decisions that were taken in the past. As a robustness check, I perform the chi-square tests for change in the investment opportunity set by omitting the interaction variables on BADTA and OREOTA. As the results are qualitatively similar to the chi-square tests performed on the entire portfolio, I do not report them in the tables.

Hypothesis 3: Contribution of changed investment opportunity set on asset risk (H3)

As the next step, hypothesis 3 tests whether the change in investment opportunity set (hypothesis 2) contributed to an increase in asset risk. To test for this, asset risk is estimated using the asset category weights in the period prior to the regime shift (d=0) and the coefficients on the dummy interaction variables in the STDEVA equation. This gives a measure of the increase (or decrease) in asset risk, if the investment opportunity set at d=1 was in place at d=0. A t-test can then be used to test the statistical significance. The t-tests reported for this hypothesis in table A-3 indicate that the change in investment opportunity, *ceteris paribus*, significantly increased the asset risk in all three regressions. However, the increase in risk in regression I, though statistically significant, is an order of magnitude smaller than the values in the other two regressions. This observation suggests that the effect of the changed investment opportunity set on asset risk is more pronounced in the latter period of the sample.

In summary, the empirical results show that the change in regulatory stance increased the sensitivity of equity ratios to risk for all banks in the sample. The empirical analysis also shows that the investment opportunity set available to banks changed over the sample period. Holding the effect of portfolio reorganization constant, the estimated effect of this change in the investment opportunity set is an increase in asset risk. The next step is to estimate the how much of the observed increases in equity ratios can be attributed to these structural shifts.

Assessing the impact on observed increases in equity ratios

Following the methodology laid out in chapter 4, I use the coefficients estimated in regression III of Table A-3 to compute the effects of the two hypotheses on the observed increases in equity ratios.[45] The results are presented in table A-4. The observed change in equity ratio is computed as the difference between the mean equity ratios in time period 1 (1992-98) and time period 0 (1986-88). All effects are computed as a percentage of the observed change in equity ratio. Table A-4 shows that effect E1, which is the pure change that can be attributed to a change in the regulatory stance, accounted for 17.04% of the observed increase in equity ratio. Similarly, effect E2 (pure change in the investment opportunity set) accounted for 11.45% of the increase and the cross-product effect, E3, contributed a further 17.70%. The response by banks in terms of portfolio reorganization amounted to a meagre 4.02%. Taken as a whole, the net effect of a change in the regulatory stance and the change in the investment opportunity can account for 50.21% of the observed increase in equity ratios. This number is significant both economically as well as a statistically

In addition, table A-4 presents the percentage of equity increase that can be attributed to an increase in the profitability of banks in the 1990s. Berger (1995) among other has

[45] Using estimates from regressions I or regression II, yields qualitatively similar results.

shown that changes in earnings and changes in equity ratios are positively correlated as banks tend to retain their earnings. Table A-4 shows that 9.5% of the observed increase in equity ratios can be attributed to this correlation. This number is computed as the product of the coefficient on the ROA variable in the regression and, the difference in the mean values of earnings between periods 1 and 0.

Proposition III in chapter 3 identified the possibility that an increase in charter value can also increase equity ratios in the banking industry. In order to compute the percentage of change in equity ratios that can be attributed to an increase (or decrease) in charter value, I first need to get an estimate for the coefficient of charter value. As the regression specification uses the dummy variable HMB to proxy for charter value, I need to back out the coefficient of charter value from the coefficient of HMB. The coefficient of charter value in the MKTRAT equation signifies the excess equity that banks that are in the top 25th percentile have when compared to the bottom 75th percentile. In other words:

$$\beta_{HMB} = \beta_{CV} (CV_{top\ 25} - CV_{bottom\ 75}) \qquad (5\text{-}5)$$

Now, if Tobin's Q can be considered as a measure of charter value then the Q values of the top 25th percentile and the bottom 75th percentile can be substituted in equation (5-5) and β_{CV} can be computed.[46] Using this methodology β_{CV} is computed to be 0.32. Now an estimate of the percentage change in equity that can be attributed to a change in charter value can be computed by taking the difference in the means of Q values in periods 1 and 0, and multiplying it with β_{CV}. The table shows that this yields a value of 25.55%

In summary the empirical analyses thus far suggest that the change in regulatory stance increased the sensitivity of equity ratios to risk. The investment opportunity set available to banks has also changed over the sample period resulting in a set of riskier projects. Both of these effects together seem to explain about 50% of the observed increase in

equity ratios. Changes in charter value also seem to have contributed to an increase of about 26% in equity ratios in the banking industry. As the charter value numbers are computed with the assumption that Tobin's Q is an accurate (error free) measure of charter value, caution needs to be exercised in the interpretation of the effect of charter value.

Robustness tests

A. Splitting the sample into finer partitions

In the analysis thus far, to test for structural shifts, the sample was partitioned into two periods motivated by the years (1989 and 1992) that earlier studies used as when the change in regulatory stance occurred. The same partitioning years were used to test the change in investment opportunity set hypothesis as well in the regressions presented in table A-3. To test whether this constraint influenced the results, I partitioned the sample period into 6 time periods and ran the tests. The time periods are - 1986-87, 1988-89, 1990-91, 1992-93, 1994-95 and 1996-98. To run the tests the empirical model presented as (5-3) and (5-4) is transformed as follows:

$$MKTRAT_{i,t} = \alpha_0 + \alpha_1 STDEVA_{i,t} + \Sigma_{t=2\ to\ 6}(\alpha_2 d_t * STDEVA_{i,t}) + \Gamma_3 HMB_{i,t} + \Gamma_4 ROA_{i,t} + \Gamma_5 LNTA_{i,t} + \Gamma_6 REGP_{i,t} + \varepsilon_{i,t} \quad (5\text{-}6)$$

$$STDEVA_{i,t} = \beta_0 + \beta_1 MKTRAT_{i,t} + \Sigma_{j=2,n}\Sigma_{t=2\ to\ 6}\{\beta_j W^j{}_{i,t} + \gamma_{j,t} d_t * W^j{}_{i,t}\} + \Lambda_2 HMB_{i,t} + \Lambda_3 REGP_{i,t} + \delta_{i,t} \quad (5\text{-}7)$$

where t takes the value of 2 through 6 indicating each time period and d_t is a dummy variable that takes the value of 1 for time period t and 0 otherwise.

Table A-5 presents the results of testing hypotheses 1 and 3. Recall that hypothesis 1 tests whether the coefficient of risk in the MKTRAT equation is different from 0 and

[46] Even if Q measures charter value with error, since we use a difference in equation (5-3) the estimate of β_{CV} is unbiased. Of course, the assumption is that the contemporaneous errors in Q are the same for all banks.

hypothesis 3 tests whether the change in investment opportunity set (All $\gamma_{j,t}$ are jointly zero) contributed to an increase in portfolio risk.

A few interesting observations can be made from the table. The coefficient on risk in the years 1986-87 (not shown) was an insignificant 2.52. In years 1988-89, this coefficient increased by 10.38 and is statistically significant at the 5% level. This period corresponds to the one that prior subordinated debt studies (ex. Flannery & Sorescu, 1996) have identified as the period when the change in regulatory stance occurred. Interestingly there seems to be another spike in the coefficient of STDEVA during the 1992-93 period. This is the period just after the adoption of FDICIA. One possible explanation for this observation is that though 1989 seems to be the year when markets significantly increased the amount of equity per unit risk that they required of banks, there was still some uncertainty about the regulators' bail out policy. Hence, the passing of FDICIA in 1991 removed this uncertainty and correspondingly we observe another spike in the 1992-93 period.

Results from the testing of hypothesis 3 also reveals some interesting patterns. Changes in the investment opportunity set, *ceteris paribus,* seem to have actually reduced asset risk in the 1988-89 and 1990-91 periods. For the remainder of 1990s, asset risk seems to have increased. This pattern might explain the reason why the increase in risk measure estimated in regression I (1989-98 -- period 1) of table A-3, is an order of magnitude lower than regressions II and III (1992-98 -- period 1).

B. Sub-Sampling

As the banking industry is highly skewed on the dimension of asset sizes of banks, it is important to understand whether the full sample results presented in tables A-3 and A-4 are robust to size sub-sampling. Also, it would be interesting to know whether there are differential impacts of the hypotheses for different asset size classes. To investigate the same, I use the earlier defined asset size classes of large banks (book value asset ranks 21-100) and mega banks (book value asset ranks 1-20) to create sub-samples. On these sub-samples, I use

the same specification as presented in (5-1) and (5-2). The results for the large and mega bank sub-samples are presented in tables A-6 and A-7 respectively.

For the large sub-sample, the results qualitatively mirror the results of the entire sample. The change in regulatory stance seems to have occurred during the 1989-1991 period and the change in the investment opportunity set seems to have increased asset risk. This result seems robust to the use of different sample partitioning years.

For the mega sub-sample, there are a few interesting observations that can be made. The coefficient on d*STDEVA is positive and statistically significant only when the sample period is partitioned at year 1991 (regression II). As these banks were the primary beneficiaries of the TBTF policy, the results in regression II could be interpreted as evidence that only with the passage of FDICIA in 1991, did the regulators credibly signal their change in their stance on bailouts for this sub-sample of banks.

In terms of hypothesis 2 as well, it seems that for the mega-banks the change in investment opportunity set didn't occur until after 1991, as the chi-square statistic is not significant for regression I and is significant at the 5% level in regression II. This result is further validated in regression III where the chi-square test statistic for hypothesis 3 is significant at the 5% level. The results of testing hypothesis 3 indicate that the value of change in risk is positive and significant at the 1% level in all three regressions.

Table A-8 presents the results of the analysis to compute the proportions of the observed increases in equity ratios that can be attributed to the various hypotheses for both sub-samples. Just as in table A-4, the numbers here are computed using the coefficients estimated through regression specification III (time period 0 - 1986-88; time period 1: 1992-98). The change in regulatory stance and the change in investment opportunity set hypotheses together contributed to about 58% of the observed increases in equity ratios for both sub-samples. The increase in charter value, seems to have contributed about 27% for the large

banks and about 21% for the mega banks. Overall, for both sub-samples the results seem to be similar to the results obtained by pooling the two.

C. Tobin's Q as a measure of charter value

Earlier, I discussed the reasons behind not using Tobin's Q in the regressions as a measure of charter value. As it is a very common proxy for charter value used in the literature (see Keeley, 1990 and Saunders & Wilson, 1996 as examples), I checked for the robustness of my results using Tobin's Q in my regressions. In essence I replaced the HMB dummy with the lag value of Tobin's Q in the specifications given by (5-3) and (5-4).[47] The results (not shown) of this robustness check reveal that even using Q, the conclusions drawn earlier about the different hypotheses are the same.

Regulators or Markets?

In this study, the approach that has been taken is to understand the determinants of optimal equity ratios for a bank in the absence of capital regulation. Using this framework, hypotheses that could potentially explain the observed increases in equity ratios were developed, and these hypotheses were subsequently empirically tested for. The implicit assumption underlying this approach is that banks aren't constrained by capital regulation and market forces determine equity ratios. Changes in the environment that banks operate in, as embodied by the hypotheses, influence the inherent tradeoffs and hence change the equity ratios. As the empirical results strongly support the hypotheses in explaining the changes in equity ratios, an important implication of this study is that markets and not regulators are influencing the equity ratios observed in the banking industry in the 1990s.

[47] Using the lagged value of Q mitigates the problem that the independent variable (q) and the dependent variable (MKTRAT) have the same (or a transformation of the same) numerator. It however does not address the EIV problem.

The prevalent paradigm in the academic literature is however, that capital regulation significantly constrains banks and hence observed equity ratios are a result of regulatory forces, not market forces. The analysis in chapter 2 clearly shows that banks in the 1990s are holding significant cushions over the regulatory minimums. In addition, it also shows that the Basle standards adopted in the early 1990s in the US was, in contradiction to popular opinion, a less stringent standard than the capital standards that they replaced. These observations, coupled with the robust results that support the 'market' hypotheses developed in this study, make it difficult to argue that banks are constrained by capital regulation and that regulators, not markets are having a dominant influence on the observed equity ratios in the banking industry.

Nevertheless, the issue warrants further investigation. In order to investigate this issue, we need to first identify a variable that is potentially influenced by both regulatory as well as market forces. The analysis thus far, focussed on market equity ratios as from a market perspective it is the variable of interest. However, regulators impose capital standards in terms of book values. They require banks to have a certain percentage of their book value of assets as equity.[48] Hence, an analysis based upon book equity ratios might be able to shed some light on whether market or regulatory forces are more influential in determining bank equity ratios. Since, market equity ratio and book equity ratio are related as given by (5-8), book equity ratios through their relation with market equity ratios are also potentially influenced by market forces.

$$\text{Market equity ratio} = 1 - (1 - \text{Book equity ratio}/\text{Tobin's Q}) \qquad (5\text{-}8)$$

The relationship presented in (5-8) allows for the analysis of book equity ratios as follows:

$$\text{Book ratio} = \alpha_0 + \alpha_1 (\text{Market measure of risk}) + \alpha_2 (\text{Regulatory measure of risk}) + \varepsilon \qquad (5\text{-}9)$$

[48] Apart from equity certain other liabilities, such as subordinated debt also count towards regulatory capital. However, equity is the predominant component of regulatory capital.

If only regulators are influencing equity ratios, then we would expect book equity ratios to be correlated with regulatory measures of risk and not the market's assessment of risk. In other words, we would expect $\alpha_2>0$ and $\alpha_1=0$.[49] Conversely, if only markets are influencing equity ratios then we would expect $\alpha_2=0$ and $\alpha_1>0$. A third possibility exists wherein both α_1 and α_2 are greater than 0. If regulatory capital standards are indeed binding, then book equity ratios would be correlated with regulatory measures of risk making $\alpha_2>0$. However, in this scenario banks would also like to hold some equity cushion above the regulatory minimum. The amount of cushion will be correlated with the market (true) measure of risk and so we should observe $\alpha_1>0$. This third scenario (both α_1 and α_2 are greater than 0) would also indicate that regulators have a significant influence on equity ratios.

Table A-9 presents the results of the regression specification presented in (5-9). As a measure of regulatory assessment of risk I use the ratio of risk weighted assets to total assets (RWA/TA) as Basle capital standards are based upon RWA. As a measure of market risk, I use the fitted values of STDEVA (STDEVA_FITTED) obtained from the regression system defined in (5-6) and (5-7). The specification also includes year dummies to control for time series effects and bank dummies to control for fixed effects. The coefficients on these dummies are though, not reported in the table.

In regression I, the coefficient on STDEVA_FITTED is 6.667 and is significant at the 1% level while the coefficient on RWA/TA is 0.002 and is statistically insignificant. The results in regression I suggest that book equity ratios are positively correlated only to the market measures of risk.

To investigate if there are any time trends associated with the two measures of risk, I partition the sample into four periods 1986-88, 1989-91, 1992-94 and 1995-98. This allows

for the estimation of separate coefficients in each time period for RWA/TA and the fitted value of STDEVA_FITTED. The results of this specification are presented as regression II of table A-9. The results show that the coefficients of STDEVA_FITTED in every time period are positive and statistically significant at the 1% level, suggesting that in cross-section banks hold higher levels of book equity ratios when they have higher levels of risk as perceived by the market. In contrast, the coefficient of RWA/TA in the 1986-88 period has the wrong sign. It is negative and significant at the 1% level. The coefficients in the 1989-91 and 1995-98 periods are positive though statistically not different from zero. Only, in the 1992-94 period is the coefficient on RWA/TA positive and statistically significant. Interestingly, this period corresponds to the period right after the adoption of FDICIA in 1991. This act mandated prompt and corrective action (PCA) on banks based upon the range in which their capital ratios fell.[50] There is conflicting evidence in the literature on the effect of the passage of this act on the banking industry. Jones and King (1995) show that the majority of the troubled banks in the 1984-89 period would not have been detected as per the capital ratio zones outlined in the act and hence would not have been subject to any mandatory corrective action. They interpret this evidence as suggestive that FDICIA had little effect on bank behavior. However, Aggarwal and Jacques (2001) provide evidence that banks raised their regulatory capital ratios subsequent to the passage of the act. They interpret this as evidence that through FDICIA-PCA regulators increased the costs for banks of non-conformance to capital standards and hence banks increased their equity ratios. Their sample period ends in 1996. The results of regression II in table A-9 corroborate their evidence in the 1992-94 period as the coefficient on RWA/TA is positive and statistically significant. However, in the 1995-98 period the coefficient on RWA/TA is not significant, suggesting that the effect of FDICIA on

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[50] For a detailed description of the he capital categories defined under PCA, see Aggarwal and Jacques (2001).

equity ratios, if any, was temporary and isolated to the 1992-94 period. Overall, the estimates in regression II of table A-9 strongly suggest that book equity ratios are correlated to market and not regulatory measures of risk.

In order to understand the marginal effect of including RWA/TA in the regression, in specification III of table A-9, I drop the RWA/TA variables from the regression specification used in II. The coefficients on STDEVA_FITTED in all time periods are virtually identical to the coefficients observed in regression II. The R-squared for regression III is 0.81 while the R-squared for regression II is 0.82 suggesting that the inclusion of the RWA/TA variables add little explanatory power.

In summary, the preceding analysis shows that book equity ratios, measures that regulators use as indicators of adherence to capital regulation, are strongly correlated to market as opposed to regulatory measures of risk. This strongly suggests that market forces as opposed to regulatory forces are strongly influencing the equity ratios observed in the banking industry. The results of the preceding analysis also validate the empirical testing of the hypotheses derived under the assumption that market forces determine the equity ratios in the banking industry. As a caveat, the results should not be interpreted as regulators can not or capital regulation does not influence any banks in the industry. The results only provide evidence that market forces are more dominant than regulatory forces for the average bank.

CHAPTER 6
CONCLUSION AND DISCUSSION

Bank equity ratios have dramatically increased over the last decade and a half. Book equity ratios today are the highest observed in the industry over the last fifty years. The last time we witnessed the levels at which the market equity ratios are presently was back during the boom years of the 1920's. This research explores the reasons behind these dramatic increases.

In this study, I first extensively document the changes to bank equity ratios over the period 1986-98. In the process, I also document the regulatory capital ratios that banks held and show the movement of the banking industry from a regulatory to a market regime. To understand and investigate potential reasons for the observed shift in regimes and increased equity ratios, I develop a model that highlights the determinants of a bank's optimal equity ratio. Using the model's framework, I derive both, theoretical propositions as well as empirically testable hypotheses that can explain the phenomenon under study.

The empirical analysis in this paper tests the proposed hypotheses on a sample of banks that on average held over 75% of all banking assets. The sample period extends from 1986 through 1998. The results show that the change in regulatory stance on bank bailouts increased the sensitivity of risk on equity ratios, thereby increasing the amount of equity banks held, per unit risk. The results also provide support to the hypothesis that the investment opportunity set available to banks changed over the sample period. After controlling for other effects, it seems that this change in the investment opportunity set increased asset risk and thus increased equity ratios of banks. These two hypotheses (change

in regulatory stance and change in investment opportunity set) together account for close to 60% of the observed changes in equity ratios.

This study makes two important contributions to the literature. Firstly, by extensively documenting the dramatic increases in equity ratios, it brings to light a phenomenon that has received little attention in the academic literature. It also establishes that changes in capital regulation can not explain the increases in equity ratios. The academic literature for long has assumed that capital structure of value maximizing banks is constrained by capital regulation. In this study, I show that there has been a shift in bank equity ratios from a regulatory to a market regime. This suggests that in analyzing bank capital structure we need to consider market forces. This paper provides a framework for understanding how market forces determine the optimal capital structure of a bank. I use this developed framework to propose three reasons that could explain the rise in equity ratios. Results of the empirical analysis provide support to the explanations proposed in this paper. The implication of the results is that market forces as opposed to regulatory forces are more influential in determining the equity ratios that we observe today in the banking industry.

Secondly, the study calls to question the relevance of the capital standards as a measure of bank health. The paper shows that capital standards have become increasingly less binding over the sample period. The June, 1999 *Federal Reserve Bulletin*, reported that as of year end 1998, 95% of the banks in the industry were "well capitalized". So, if we measure the health of the banking industry as adherence to capital standards, then we can conclude that the banking industry has become a lot safer over the sample period. But, this conclusion might be hasty. If the capital standards in place do not accurately reflect the risks of the environment that banks operate in today, then measuring the health of the industry using these standards, represents a case of using an incorrect benchmark, and hence meaningless. This study empirically establishes that over the sample period banking activity has become riskier. Markets have responded by requiring banks to hold more equity as a

response to the increased risk in banking activity. On the other hand, standards of measuring capital adequacy have not changed. As a result, regulators certify more than 95% of the banks as "well capitalized" and hence imply that they are safe. But are they? Only time will tell.

APPENDIX A

TABLES

Table A1: Percentage of banks in a regulatory regime

This table shows for each year, the percentage of banks that can be considered to be in a regulatory regime. A bank is considered to be in a regulatory regime if the capital cushion that it holds is less than 1.5% in excess of the regulatory minimum. For the period 1986-91, the pre-Basle capital standards are used and for the period 1992-98, the Basle capital standards are used. Data to compute these percentages is from the Y-9C quarterly data maintained by the Federal Reserve on BHCs. The sample includes for each quarter, the 1000 largest BHCs, yielding a total of 51,000 bank quarters over the entire sample period.

Panel A: By asset size classification

	Small Banks			Medium Banks			Large Banks			Mega Banks		
YEAR	**Below Regulatory standards (%)**	**> Reg. Standard & <Reg. Standard +1.5% (%)**	**Percentage constrained by Reg. Standards**	**Below Regulatory standards (%)**	**> Reg. Standard & <Reg. Standard +1.5% (%)**	**Percentage constrained by Reg. Standards**	**Below Regulatory standards (%)**	**> Reg. Standard & <Reg. Standard +1.5% (%)**	**Percentage constrained by Reg. Standards**	**Below Regulatory standards (%)**	**> Reg. Standard & <Reg. Standard +1.5% (%)**	**Percentage constrained by Reg. Standards**
1986	19.4%	26.5%	45.9%	6.8%	31.2%	37.9%	1.7%	39.2%	40.8%	23.3%	40.0%	63.3%
1987	17.9%	25.2%	43.1%	4.8%	23.8%	28.5%	2.2%	32.2%	34.4%	2.5%	41.3%	43.8%
1988	15.2%	23.3%	38.5%	6.1%	22.7%	28.8%	4.1%	29.4%	33.4%	0.0%	36.3%	36.3%
1989	13.2%	21.3%	34.5%	5.0%	19.5%	24.5%	2.5%	31.6%	34.1%	1.3%	22.5%	23.8%
1990	12.3%	22.1%	34.4%	6.2%	18.4%	24.6%	2.2%	33.4%	35.6%	1.3%	22.5%	23.8%
1991	9.4%	23.4%	32.8%	6.4%	19.1%	25.6%	2.8%	20.0%	22.8%	0.0%	1.3%	1.3%
1992	4.1%	6.1%	10.2%	3.9%	4.5%	8.4%	1.6%	5.0%	6.6%	1.3%	11.3%	12.5%
1993	2.6%	4.1%	6.7%	1.1%	1.0%	2.1%	0.0%	0.3%	0.3%	0.0%	0.0%	0.0%
1994	1.7%	3.3%	5.0%	0.3%	1.3%	1.6%	0.0%	0.9%	0.9%	0.0%	0.0%	0.0%
1995	1.0%	2.8%	3.8%	0.0%	1.5%	1.5%	0.0%	0.9%	0.9%	0.0%	0.0%	0.0%
1996	1.1%	3.7%	4.8%	0.3%	1.4%	1.6%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1997	0.9%	5.4%	6.3%	0.1%	2.0%	2.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1998	1.5%	5.8%	7.3%	0.3%	1.7%	2.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%

Table A1 (contd.)

Panel B: All banks

YEAR	Below Regulatory standards (%)	> Reg. Standard & <Reg. Standard +1.5% (%)	Percentage constrained by Reg. Standards
1986	13.0%	29.6%	42.6%
1987	11.1%	25.5%	36.6%
1988	10.4%	23.8%	34.2%
1989	8.8%	21.4%	30.3%
1990	8.8%	21.5%	30.4%
1991	7.5%	21.0%	28.5%
1992	3.8%	5.5%	9.3%
1993	1.8%	2.5%	4.2%
1994	1.0%	2.3%	3.2%
1995	0.5%	2.1%	2.6%
1996	0.7%	2.4%	3.0%
1997	0.5%	3.5%	4.0%
1998	0.9%	3.6%	4.4%

TABLE A-2: Snapshot of balance sheets of all banks in 1986 and 1998

	1986	*1998*	*Percentage change*
Equity ratio	0.0770	0.1864	142.09
stdeva	0.0014	0.0053	289.57
Total assets	19.3000	47.1000	144.04
ROA	0.0071	0.0127	78.09
Bad loans/ Total assets	0.0150	0.0050	-66.52
Oreo/ Total assets	0.0023	0.0007	-68.54
Securities/ Total assets	0.1493	0.2186	46.43
Federal funds/ Total assets	0.0337	0.0277	-17.80
Trading assets/ Total assets	0.0098	0.0201	106.21
Real estate loans/ Total assets	0.1761	0.3131	77.84
C&I loans/ Total assets	0.2163	0.1529	-29.31
Agricultural loans/ Total assets	0.0055	0.0050	-9.26
Other loans/ Total assets	0.2341	0.1513	-35.35
Herfindahl of loans	0.3560	0.4338	21.85
Intangibles/ Total assets	0.0060	0.0154	154.56
OBS/ Total assets	0.4915	2.0985	326.96

Table A-3 : 3sls regression results for all banks in the sample

This table provides the results of the 3sls regressions run on the entire sample of banks. The sample period extends from 1986-1998. Variable definitions are provided in appendix C. In regression I, the dummy variable takes the value of 1 for the years 1989-98 and 0 for the years 1986-1988. In regression II, the dummy variable takes the value of 1 for the years 1992-98 and 0 for the years 1986-1991. In regressions III, the dummy variable takes the value of 1 for the years 1992-98 and 0 for the years 1986-1988. All regressions include a dummy for each bank in the sample as well as year dummies. The coefficients of these dummies are not reported. The table reports the coefficients on all the other variables included in the specification. Standard errors are provided in parantheses. All coefficients for the STDEVA equation are multiplied by 10^3

	I		II		III	
Dependent Variable :MKTRAT	d=0:1986-88;d=1:1989-98		d=0:1986-91;d=1:1992-98		d=0:1986-88;d=1:1992-98	
STDEVA	7.364	(4.895)	20.011 ***	(4.369)	6.563	(5.707)
d*STDEVA	10.075 **	(4.629)	-0.877	(3.988)	10.146 *	(5.465)
HMB	0.021 ***	(0.002)	0.019 ***	(0.002)	0.021 ***	(0.002)
ROA	0.958 ***	(0.079)	0.876 ***	(0.082)	1.020 ***	(0.104)
REGP	-0.001	(0.002)	-0.001	(0.002)	-0.001	(0.002)
LNTA	-0.005 **	(0.002)	-0.003 *	(0.002)	-0.004	(0.002)
CONSTANT	0.104 ***	(0.038)	0.064 *	(0.035)	0.075 *	(0.044)
R-sq	0.935		0.933		0.938	
Dependent variable: STDEVA						
MKTRAT	24.409 ***	(0.982)	23.517 ***	(0.963)	24.066 ***	(1.159)
HMB	-0.325 ***	(0.068)	-0.305 ***	(0.066)	-0.317 ***	(0.083)
REGP	0.183 ***	(0.071)	0.169 ***	(0.069)	0.127	(0.105)
d	1.398	(1.193)	-1.929 *	(1.012)	0.327	(1.445)
BADTA	17.016 ***	(5.993)	12.990 ***	(3.623)	17.377 ***	(6.617)
d*BADTA	-9.899	(6.823)	-16.209 **	(7.004)	-19.962 **	(9.487)
OREOTA	-4.618	(14.286)	1.474	(8.405)	-3.016	(15.766)
d*OREOTA	30.564 *	(16.089)	39.255 ***	(14.082)	46.251 **	(20.372)
SECTA	0.004	(1.166)	-0.644	(0.793)	-0.207	(1.295)
d*SECTA	0.059	(1.332)	1.313	(1.151)	1.022	(1.608)
FFREPTA	-1.533	(1.822)	-0.824	(1.312)	-1.704	(2.009)
d*FFREPTA	1.906	(2.162)	1.596	(1.946)	2.611	(2.591)
TRADETA	-1.546	(5.074)	-0.079	(1.896)	-1.574	(5.584)
d*TRADETA	0.461	(5.142)	-0.393	(2.118)	1.200	(5.685)
RLOANTA	-0.979	(1.054)	-0.909	(0.719)	-1.610	(1.162)
d*RLOANTA	-0.078	(1.224)	0.017	(1.066)	0.577	(1.472)
CILNTA	-1.342	(1.328)	-0.597	(0.898)	-1.921	(1.468)
d*CILNTA	1.443	(1.516)	1.317	(1.303)	2.705	(1.822)
AGLNTA	-3.952	(6.635)	-0.878	(3.845)	-6.008	(7.386)
d*AGLNTA	4.011	(7.152)	0.279	(5.088)	5.705	(8.31)
OTHLNTA	-2.120 *	(1.155)	-2.092 ***	(0.773)	-2.588 **	(1.274)
d*OTHLNTA	1.275	(1.317)	2.168 *	(1.128)	2.488	(1.587)

Table A-3 (contd.)

	I		II		III	
HERFLN	1.412	(1.645)	0.035	(0.673)	1.095	(1.812)
d*HERFLN	-1.245	(1.678)	0.327	(0.786)	-0.687	(1.87)
INTANTA	0.334	(8.604)	-4.636	(6.065)	1.867	(9.498)
d*INTANTA	1.958	(9.014)	8.907	(6.708)	1.919	(10.054)
MISCTA	4.853 *	(2.815)	2.550	(1.797)	4.725	(3.112)
d*MISCTA	-0.759	(3.238)	3.430	(2.8)	1.457	(3.96)
OBSTA	0.049	(0.08)	0.014	(0.029)	0.052	(0.088)
d*OBSTA	-0.035	(0.081)	-0.012	(0.033)	-0.047	(0.089)
CONSTANT	-0.526	(1.026)	0.109	(0.66)	0.015	(1.137)
R-sq	0.789		0.794		0.793	
No. of obs	1113		1113		849	

HYPOTHESES

H1: Change in regulatory stance Hypothesis: Coefficient on d*STDEVA <=0 Test Statistic: Z-statistic Reported values: Coefficient (standard error)	10.075 **	(4.629)	-0.877	(3.988)	10.146 *	(5.465)
H2: Change in investment opportunity set Hypothesis: Coefficients on dummy interaction variables in STDEVA regression are jointly = 0 Test Statistic: Chi-square Reported values: Chi-square value	100.100 ***		47.530 ***		82.960 ***	
H3: Change in risk due to change in investment opportunity set Hypothesis: Change in risk due to change in investment opportunity set is = 0 Test Statistic: t-statistic Reported value: Mean (standard deviation)	0.101 ***	(0.009)	1.209 ***	(0.009)	1.146 ***	(0.013)

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table A-4: Contributions of Hypotheses on the observed changes in equity ratios (All banks)

Observed change in MKTRAT -- 6.55%

Contributions	As a percentage of observed change in MKTRAT
E1 : The effect of a pure change in the regulatory stance on bank bailouts -- $\frac{\partial E}{\partial \alpha} d\alpha$	17.04 **
E2: The effect of a pure change in the investment opportunity set -- $\frac{\partial E}{\partial \beta} d\beta$	11.45
E3:The cross product effect of a pure change in investment opportunity set and a pure change in the regulatory stance on bank bailouts -- $\frac{\partial^2 E}{\partial \alpha \partial \beta} d\alpha d\beta$	17.70
E4: The effect of portfolio reorganization as a response to the above three effects -- $\frac{\partial E}{\partial W}\left[\frac{\partial W}{\partial \alpha} d\alpha + \frac{\partial^2 W}{\partial \alpha \partial \beta} d\alpha d\beta + \frac{\partial W}{\partial \beta} d\beta\right]$	4.02
Net effect of the change in regulatory stance and a change in the investment opportunity set (Sum of E1 through E4)	50.21 ***
Change in Charter Value	25.55 ***
Change in Earnings	9.50 ***

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table A-5: Robustness test on 3SLS regressions on all banks

This table provides the results of testing hypotheses 1 and 3 using 3sls regressions run on the entire sample of banks. The sample period extends from 1986-1998. Variable definitions are provided in appendix C. The sample period is partitioned into 6 time periods - 196-87, 1988-89, 1990-91, 1992-93, 1994-95 and 1996-98. The table reports only the results of testing hypotheses 1 and 3.

	H1: Change in regulatory stance Hypothesis: Coefficient on d*STDEVA <=0 Test Statistic: Z-statistic Reported values: Coefficient (standard error)		**H3: Change in risk due to change in investment opportunity set** Hypothesis: Change in risk due to change in investment opportunity set is = 0 Test Statistic: t-statistic Reported value: Mean (standard deviation)	
1988-89	-0.00055 ***	(0.00014)	10.38 **	(4.257)
1990-91	-0.00103 ***	(0.00022)	7.72 *	(4.267)
1992-93	0.00109 ***	(0.00026)	19.29 ***	(4.561)
1994-95	0.00103 ***	(0.00031)	16.49 ***	(4.824)
1996-98	0.00144 ***	(0.00089)	13.33 ***	(4.817)

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table A-6: 3sls regression results for Large banks

This table provides the results of the 3sls regressions run on the large banks (asset ranks 21-100). The sample period extends from 1986-1998. Variable definitions are provided in appendix C. In regression I, the dummy variable takes the value of 1 for the years 1989-98 and 0 for the years 1986-1988. In regression II, the dummy variable takes the value of 1 for the years 1992-98 and 0 for the years 1986-1991. In regressions III, the dummy variable takes the value of 1 for the years 1992-98 and 0 for the years 1986-1988. All regressions include a dummy for each bank in the sample as well as year dummies. The coefficients of these dummies are not reported. The table reports the coefficients on all the other variables included in the specification. Standard errors are provided in parantheses. All coefficients for the STDEVA equation are multiplied by 10^3

	I		II		III	
Depndent Variable :MKTRAT	d=0:1986-88;d=1:1989-98		d=0:1986-91;d=1:1992-98		d=0:1986-88;d=1:1992-98	
STDEVA	-5.625	(7.355)	15.780 ***	(5.02)	-6.030	(6.996)
d*STDEVA	17.824 ***	(6.931)	-0.506	(4.567)	17.941 ***	(6.705)
HMB	0.022 ***	(0.002)	0.019 ***	(0.002)	0.022 ***	(0.002)
ROA	1.076 ***	(0.094)	0.999 ***	(0.095)	1.309 ***	(0.129)
REGP	0.000	(0.002)	0.000	(0.002)	0.000	(0.003)
LNTA	-0.001	(0.003)	0.001	(0.003)	0.003	(0.003)
CONSTANT	0.053	(0.05)	-0.007	(0.044)	-0.022	(0.054)
R-sq	0.941		0.933		0.947	
Dependent variable: STDEVA						
MKTRAT	22.354 ***	(1.124)	21.994 ***	(1.095)	22.071 ***	(1.337)
HMB	-0.189 **	(0.08)	-0.202 ***	(0.077)	-0.189 *	(0.097)
REGP	0.179 **	(0.084)	0.170 **	(0.082)	0.135	(0.129)
d	0.181	(1.488)	-4.555 ***	(1.258)	-4.835 ***	(1.807)
BADTA	16.640 **	(7.581)	12.852 ***	(4.641)	16.229 *	(8.303)
d*BADTA	-11.418	(8.921)	-21.593 **	(9.612)	-24.579 *	(12.724)
OREOTA	-4.121	(17.402)	0.775	(10.591)	0.076	(19.108)
d*OREOTA	34.492 *	(19.976)	47.837 ***	(17.888)	53.785 **	(25.24)
SECTA	0.656	(1.412)	-0.252	(0.951)	0.417	(1.556)
d*SECTA	1.703	(1.648)	4.618 ***	(1.484)	4.497 **	(2.033)
FFREPTA	-1.253	(2.072)	-0.469	(1.495)	-1.560	(2.265)
d*FFREPTA	5.536 **	(2.593)	7.608 ***	(2.521)	9.343 ***	(3.245)
TRADETA	1.426	(9.454)	1.663	(4.611)	-0.034	(10.298)
d*TRADETA	3.933	(9.904)	6.918	(5.682)	9.201	(10.995)
RLOANTA	-0.856	(1.249)	-0.826	(0.835)	-1.618	(1.362)
d*RLOANTA	2.269	(1.503)	4.044 ***	(1.416)	5.065 ***	(1.889)
CILNTA	-1.024	(1.616)	-0.478	(1.083)	-1.664	(1.776)
d*CILNTA	2.519	(1.86)	3.960 ***	(1.621)	5.503 ***	(2.247)
AGLNTA	1.097	(7.809)	1.552	(4.288)	-1.579	(8.637)
d*AGLNTA	-1.203	(8.41)	-2.160	(5.707)	1.701	(9.686)
OTHLNTA	-1.866	(1.338)	-2.007 **	(0.874)	-2.308	(1.462)
d*OTHLNTA	2.789 *	(1.541)	4.816 ***	(1.329)	5.256 ***	(1.868)

Table A-6 (contd.)

	I		II		III	
HERFLN	1.648	(2.2)	0.296	(0.955)	1.139	(2.393)
d*HERFLN	-2.360	(2.27)	-1.263	(1.158)	-2.134	(2.505)
INTANTA	0.540	(10.199)	-5.231	(7.459)	0.607	(11.145)
d*INTANTA	1.169	(11.168)	10.502	(8.842)	3.683	(12.426)
MISCTA	4.350	(3.507)	1.521	(2.247)	3.937	(3.836)
d*MISCTA	3.120	(4.138)	11.032 ***	(3.726)	9.165 *	(5.132)
OBSTA	-0.053	(0.242)	-0.021	(0.08)	-0.099	(0.263)
d*OBSTA	0.165	(0.246)	0.136	(0.098)	0.231	(0.271)
CONSTANT	-0.703	(1.275)	0.040	(0.771)	-0.014	(1.396)
R-sq	0.780		0.794		0.783	
No. of obs	860		860		656	
HYPOTHESES						
H1: Change in regulatory stance Hypothesis: Coefficient on d*STDEVA <=0 Test Statistic: Z-statistic Reported values: Coefficient (standard error)	17.824 ***	(6.931)	-0.506	(4.567)	17.941 ***	(6.705)
H2: Change in investment opportunity set Hypothesis: Coefficients on dummy interaction variables in STDEVA regression are jointly = 0 Test Statistic: Chi-square Reported values: Chi-square value	79.660 ***		48.620 ***		28.240 **	
H3: Change in risk due to change in investment opportunity set Hypothesis: Change in risk due to change in investment opportunity set is = 0 Test Statistic: t-statistic Reported value: Mean (standard deviation)	1.388 ***	(0.013)	1.233 ***	(0.009)	4.031 ***	(0.022)

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table A-7 : 3sls regression results for Mega banks

This table provides the results of the 3sls regressions run on the mega banks (asset ranks 1-20). The sample period extends from 1986-1998. Variable definitions are provided in appendix C. In regression I, the dummy variable takes the value of 1 for the years 1989-98 and 0 for the years 1986-1988. In regression II, the dummy variable takes the value of 1 for the years 1992-98 and 0 for the years 1986-1991. In regressions III, the dummy variable takes the value of 1 for the years 1992-98 and 0 for the years 1986-1988. All regressions include a dummy for each bank in the sample as well as year dummies. The coefficients of these dummies are not reported. The table reports the coefficients on all the other variables included in the specification. Standard errors are provided in parantheses. All coefficients for the STDEVA equation are multiplied by 10^3.

	I		II		III	
Dependent Variable :MKTRAT	d=0:1986-88;d=1:1989-98		d=0:1986-91;d=1:1992-98		d=0:1986-88;d=1:1992-98	
STDEVA	25.103 ***	(6.072)	16.689 ***	(5.199)	22.865 ***	(6.32)
d*STDEVA	5.062	(6.062)	13.510 ***	(5.127)	6.810	(6.385)
HMB	0.020 ***	(0.003)	0.021 ***	(0.003)	0.019 ***	(0.004)
ROA	0.396 ***	(0.146)	0.513 ***	(0.151)	0.281 *	(0.172)
REGP	-0.004	(0.004)	-0.006 *	(0.004)	-0.005	(0.005)
LNTA	-0.008 ***	(0.003)	-0.010 ***	(0.003)	-0.010 ***	(0.004)
CONSTANT	0.165 ***	(0.056)	0.203 ***	(0.062)	0.218 ***	(0.071)
R-sq	0.934		0.946		0.942	
Dependent variable: STDEVA						
MKTRAT	28.843 ***	(1.835)	27.995 ***	(1.852)	28.933 ***	(2.071)
HMB	-0.647 ***	(0.111)	-0.610 ***	(0.109)	-0.623 ***	(0.135)
REGP	0.159	(0.109)	0.158	(0.105)	0.099	(0.145)
d	0.762	(1.833)	0.755	(1.827)	0.680	(2.422)
BADTA	8.681	(8.031)	4.756	(5.19)	9.416	(8.839)
d*BADTA	-1.032	(8.724)	1.276	(8.457)	-4.397	(11.207)
OREOTA	14.002	(25.)	21.309	(13.534)	10.327	(27.803)
d*OREOTA	-10.623	(26.367)	-13.675	(21.289)	-6.184	(32.704)
SECTA	-2.987	(1.998)	-1.081	(1.373)	-3.317	(2.252)
d*SECTA	1.312	(2.111)	-1.169	(1.77)	1.545	(2.497)
FFREPTA	-3.834	(3.826)	-3.421	(2.529)	-3.147	(4.317)
d*FFREPTA	1.847	(4.069)	0.934	(3.111)	1.369	(4.685)
TRADETA	-6.031	(5.272)	-1.009	(1.933)	-7.567	(5.757)
d*TRADETA	5.024	(5.327)	-0.379	(2.297)	7.000	(5.849)
RLOANTA	-2.330	(2.007)	-0.937	(1.497)	-2.867	(2.283)
d*RLOANTA	0.344	(2.178)	-1.390	(1.975)	1.023	(2.615)
CILNTA	-1.503	(2.184)	-0.500	(1.579)	-1.333	(2.456)
d*CILNTA	1.110	(2.381)	-0.063	(2.165)	1.331	(2.873)
AGLNTA	-18.847	(12.227)	-5.457	(9.809)	-22.132 *	(13.543)
d*AGLNTA	34.805 ***	(13.88)	26.031 **	(13.277)	40.479 ***	(16.832)
OTHLNTA	-1.546	(2.195)	-0.498	(1.653)	-1.817	(2.466)
d*OTHLNTA	-0.440	(2.46)	-2.199	(2.317)	-0.328	(3.026)

Table A-7 (contd.)

	I		II		III	
HERFLN	0.822	(2.073)	1.880	(1.324)	0.584	(2.388)
d*HERFLN	-0.858	(2.135)	-2.151	(1.636)	-1.249	(2.548)
INTANTA	-12.768	(14.537)	-15.199 *	(8.393)	-12.653	(16.562)
d*INTANTA	11.159	(14.656)	12.376	(8.896)	10.695	(16.811)
MISCTA	7.000 *	(3.778)	2.916	(2.609)	8.370 **	(4.207)
d*MISCTA	-5.732	(4.151)	-0.986	(3.587)	-5.493	(4.907)
OBSTA	-0.050	(0.083)	0.022	(0.027)	-0.068	(0.093)
d*OBSTA	0.076	(0.083)	0.007	(0.029)	0.094	(0.093)
CONSTANT	0.389	(1.823)	-0.828	(1.379)	0.609	(2.093)
R-sq	0.888		0.894		0.899	
No. of obs	253		253		193	
HYPOTHESES						
H1: Change in regulatory stance Hypothesis: Coefficient on d*STDEVA <=0 Test Statistic: Z-statistic Reported values: Coefficient (standard error)	5.062	(6.062)	13.510 ***	(5.127)	6.810	(6.385)
H2: Change in investment opportunity set Hypothesis: Coefficients on dummy interaction variables in STDEVA regression are jointly = 0 Test Statistic: Chi-square Reported values: Chi-square value	13.450		26.680 **		26.450 **	
H3: Change in risk due to change in investment opportunity set Hypothesis: Change in risk due to change in investment opportunity set is = 0 Test Statistic: t-statistic Reported value: Mean (standard deviation)	0.161 ***	(0.028)	1.556 ***	(0.015)	0.275 ***	(0.034)

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table A-8: Contributions of Hypotheses on the observed changes in equity ratios

Panel A: Large Banks

Observed change in MKTRAT -- 6.41%

Contributions	**As a percentage of observed change in MKTRAT**
E1 : The effect of a pure change in the regulatory stance on bank bailouts -- $\frac{\partial E}{\partial \alpha} d\alpha$	33.61 ***
E2: The effect of a pure change in the investment opportunity set -- $\frac{\partial E}{\partial \beta} d\beta$	-37.92
E3:The cross product effect of a pure change in investment opportunity set and a pure change in the regulatory stance on bank bailouts -- $\frac{\partial^2 E}{\partial \alpha \partial \beta} d\alpha d\beta$	112.82 **
E4: The effect of portfolio reorganization as a response to the above three effects -- $\frac{\partial E}{\partial W}\left[\frac{\partial W}{\partial \alpha} d\alpha + \frac{\partial^2 W}{\partial \alpha \partial \beta} d\alpha d\beta + \frac{\partial W}{\partial \beta} d\beta\right]$	-50.72 *
Net effect of the change in regulatory stance and a change in the investment opportunity set (Sum of E1 through E4)	57.79 ***
Change in Charter Value	26.79 ***
Change in Earnings	9.81 ***

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table A-8: Contd.

Panel B: Mega Banks

Observed change in MKTRAT -- 7.12%

Contributions	As a percentage of observed change in MKTRAT
E1 : The effect of a pure change in the regulatory stance on bank bailouts -- $\frac{\partial E}{\partial \alpha} d\alpha$	8.61
E2: The effect of a pure change in the investment opportunity set -- $\frac{\partial E}{\partial \beta} d\beta$	8.51
E3:The cross product effect of a pure change in investment opportunity set and a pure change in the regulatory stance on bank bailouts -- $\frac{\partial^2 E}{\partial \alpha \partial \beta} d\alpha d\beta$	2.53
E4: The effect of portfolio reorganization as a response to the above three effects -- $\frac{\partial E}{\partial W}\left[\frac{\partial W}{\partial \alpha} d\alpha + \frac{\partial^2 W}{\partial \alpha \partial \beta} d\alpha d\beta + \frac{\partial W}{\partial \beta} d\beta\right]$	38.97
Net effect of the change in regulatory stance and a change in the investment opportunity set (Sum of E1 through E4)	58.62 ***
Change in Charter Value	21.00 ***
Change in Earnings	4.26 ***

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

Table A-9 Book equity ratio regressions

This table provides the results of regressions run on all banks in the sample. The sample period extends from 1986-1998. All regressions include a dummy for each bank in the sample as well as year dummies. The coefficients of these dummies are not reported. The table reports the coefficients on all the other variables included in the specification. Standard errors are provided in parantheses.

Dependent variable - Book equity ratio

	I		II		III	
STDEVA_FITTED	6.667 ***	(0.843)				
STDEVA_FITTED - 1986-88			11.588 ***	(1.398)	12.913 ***	(1.518)
STDEVA_FITTED - 1989-91			12.965 ***	(1.335)	13.135 ***	(1.281)
STDEVA_FITTED - 1992-94			8.354 ***	(1.102)	8.504 ***	(1.045)
STDEVA_FITTED - 1995-98			5.300 ***	(0.841)	5.260 ***	(0.789)
RWA/TA	0.002	(0.006)				
RWA/TA - 1986-88			-0.017 **	(0.008)		
RWA/TA - 1989-91			0.006	(0.006)		
RWA/TA - 1992-94			0.032 ***	(0.006)		
RWA/TA - 1995-98			0.008	(0.006)		
Constant	0.058 ***	(0.006)	0.063 ***	(0.008)	0.054 ***	(0.003)
R-Square	0.794		0.820		0.810	
Observations	1101		1101		1101	

*** Significant at the 1% level
** Significant at the 5% level
* Significant at the 10% level

APPENDIX B

FIGURES

Figure B-1: Trends in book and market equity ratios for the banking industry : 1986-1998

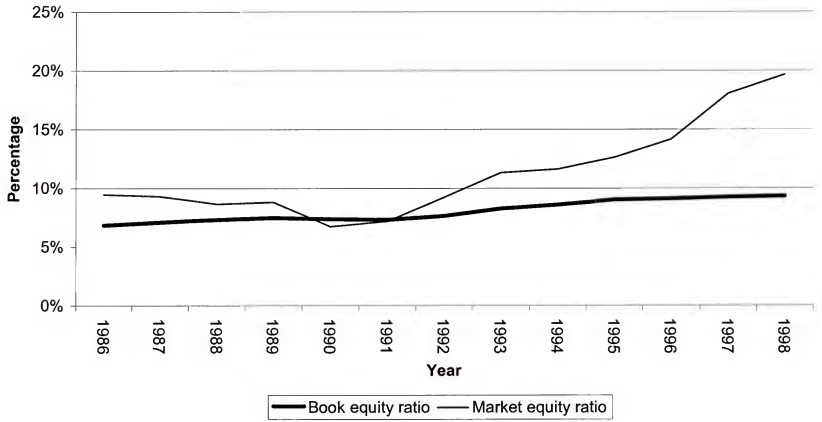
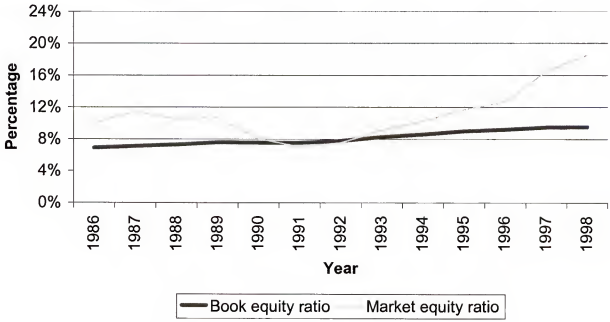
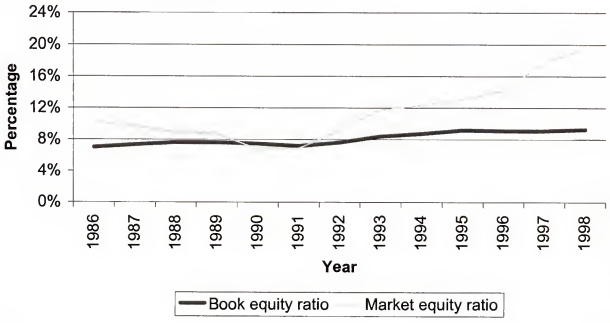


Figure B-2: Trends in book and market equity ratios of banks classified by size 1986-98

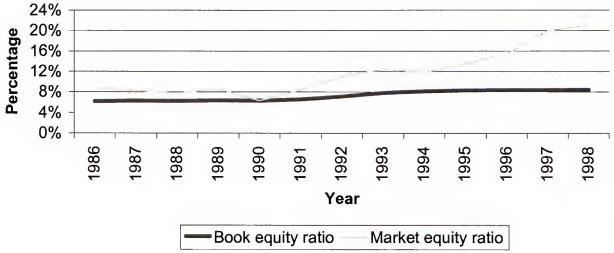
Panel A: Small banks : Asset ranks 501-1000



Panel B: Medium-sized banks : Asset ranks 101-500



Panel C: Large banks : Asset ranks 21-100



Panel D: Mega banks : Asset ranks 1-20

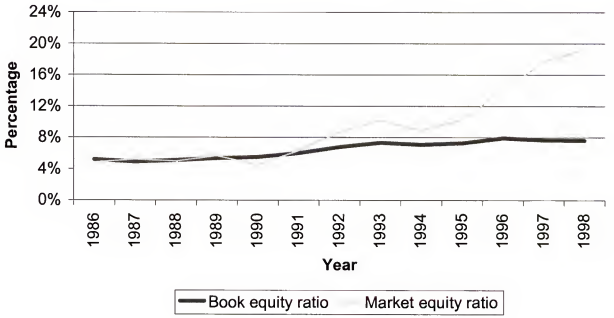
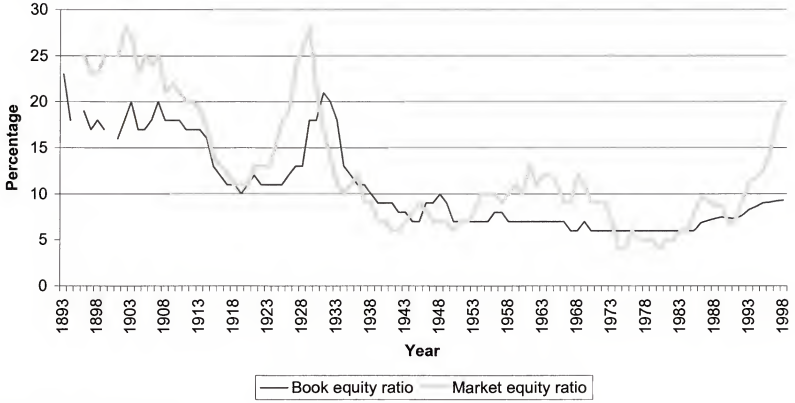


Figure B-3: Trends in book and market equity ratios for the banking industry: 1893-1998



Source: Saunders and Wilson (1996)

Figure B-4: Trends in book and market equity ratios for industrial firms : 1986-1998

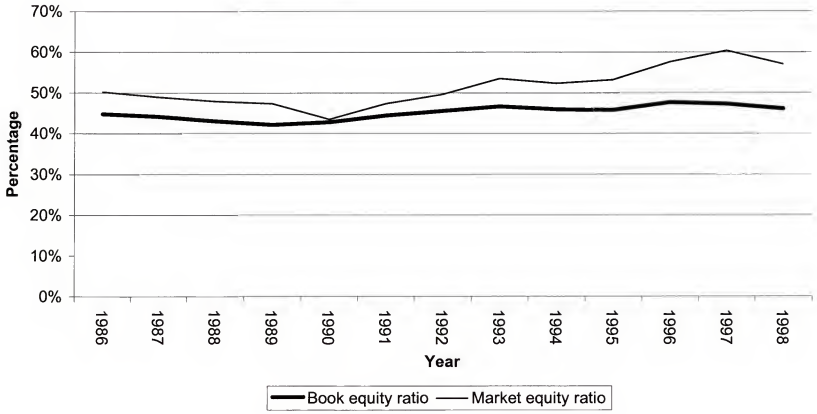


Figure B-5: Market or regulatory regime?

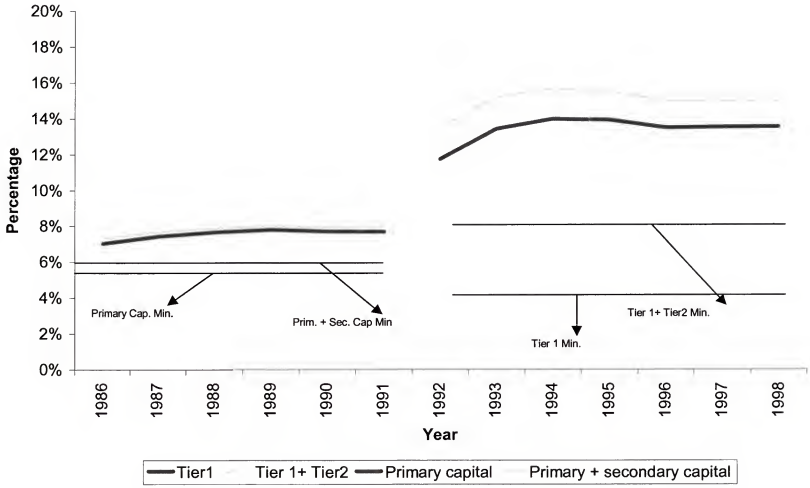
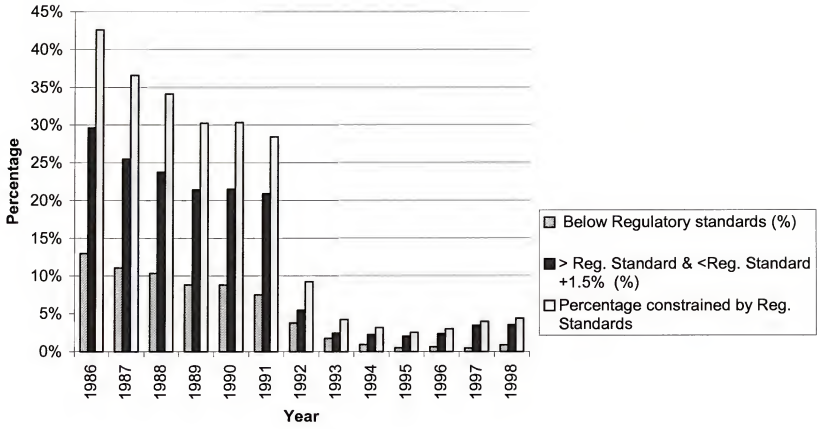
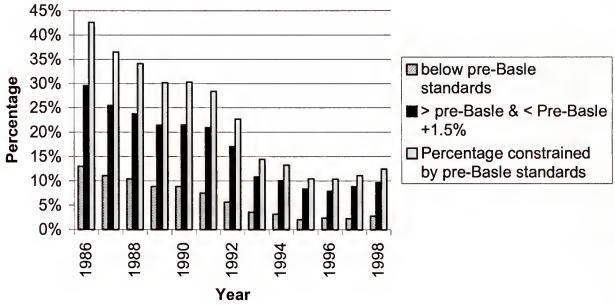


Figure B-6: Percentage of banks in a regulatory regime

Panel A: Using pre-Basle standards for the period 1986-91 and the Basle standards for 1992-98



Panel B: Using the pre-Basle standards for the entire sample period : 1986-98



Panel C: Using the Basle standards for the entire sample period : 1986-98

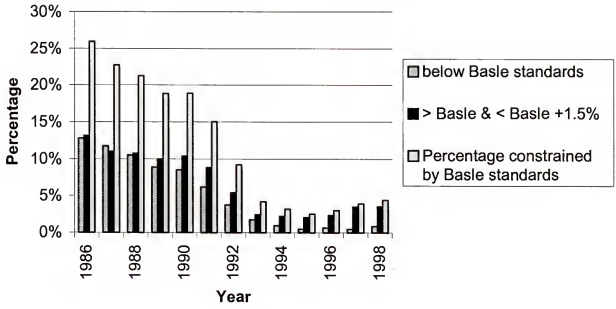


Figure B-7: Adherence to Basle standards - All banks

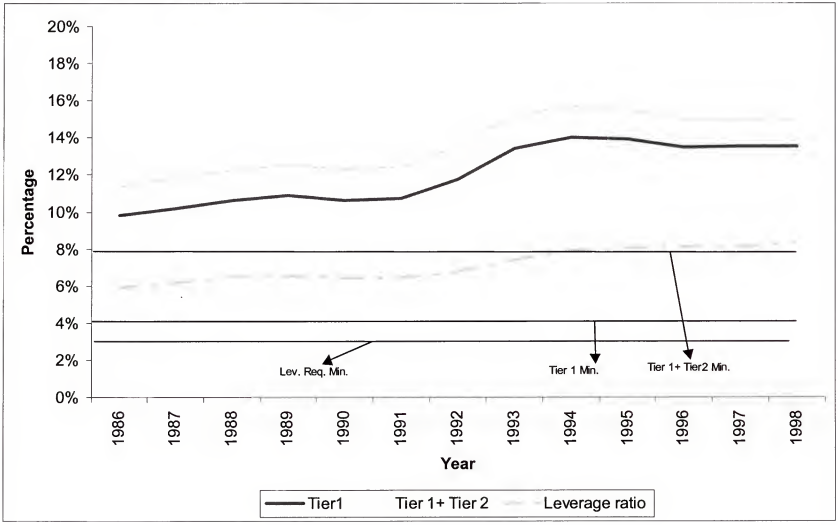
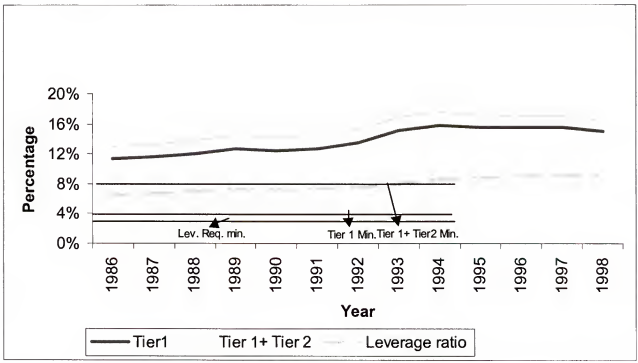
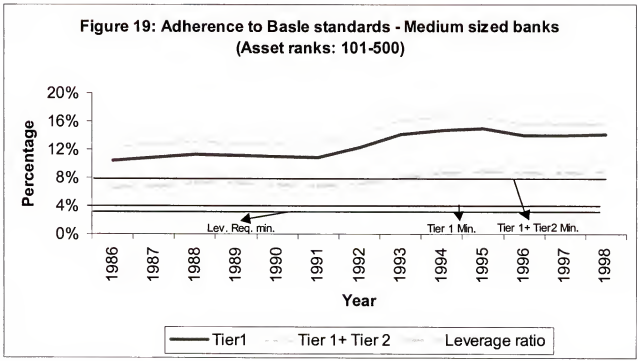


Figure B-8: Adherence to Basle standards - Banks classified by asset size

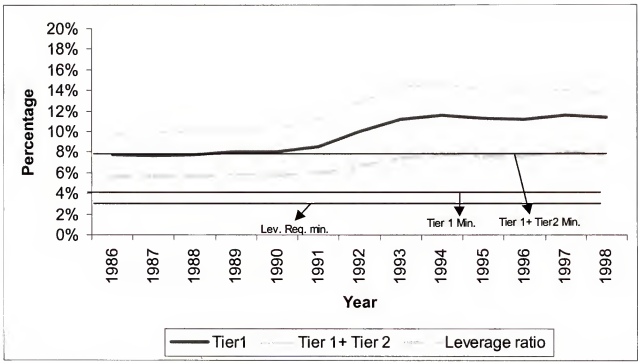
Panel A: Small banks : Asset ranks - 501-1000



Panel B: Medium-sized banks: Asset ranks - 101-500



Panel C: Large banks : Asset ranks - 21-100



Panel D: Mega banks : Asset ranks 1-20

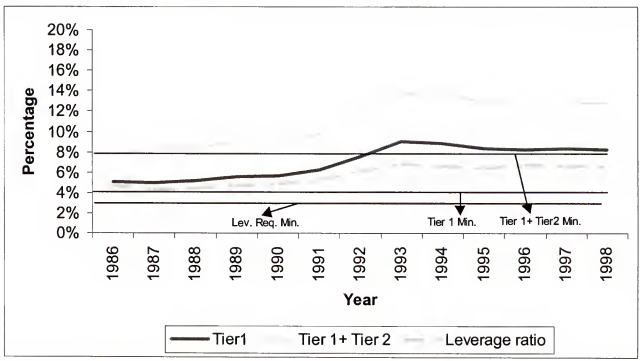
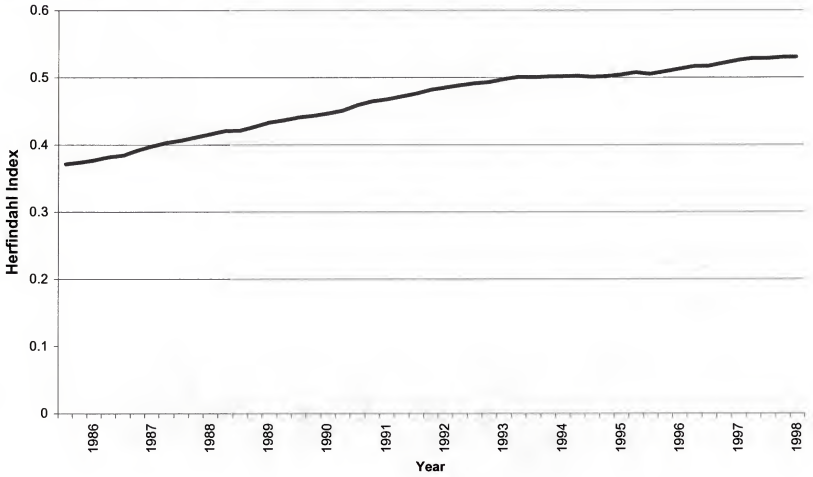


Figure B-9: Concentration of asset loan classes on balance sheet



APPENDIX C
VARIABLE DEFINITIONS

Variable definitions

Variable Name	Description
AGLNTA	Ratio of agricultural loans to total assets
BADTA	Ratio of past due loans and non-accruing loans to total assets
CILNTA	Ratio of C & I loans to total assets
FFREPTA	Ratio of federal funds sold and securities purchased under agreements to resell to total assets
HERFLN	Herfindahl index of loans on the balance sheet
INTANTA	Ratio of intangible assets to total assets
LNTA	Natural log of total assets
MISCTA	Ratio of all other assets (premises and fixed assets, investments in unconsolidated subsidiaries and associated companies, customers' liabilities on acceptances outstanding and other assets) to total assets
MKTRAT	Equity ratio ; computed as the market value of equity divided by the market value of assets
OBSTA	Ratio of the notional value of all off-balance sheet assets to total on-balance sheet assets
OREOTA	Ratio of other real estate owned to total assets
OTHLNTA	Ratio of other loans to total assets
REGP	A dummy variable that takes the value 1 if the bank is below the capital standard in place
RLOANTA	Ratio of real estate loans to total assets
ROA	Net income divided by total assets
SECTA	Ratio of securities owned to total assets
STDEVA	Standard deviation of assets; computed as the standard deviation of the daily equity returns, computed over a quarter, multiplied by the equity ratio
TRADETA	Ratio of trading assets to total assets

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BIOGRAPHICAL SKETCH

Kasturi P. Rangan, the son of N. Padmanabahan and Jana Iyer, was born in New Delhi, India, on June 17, 1974. He earned a Bachelor of Engineering (Honours) degree with a concentration in mechanical engineering at the Birla Institute of Technology and Science, Pilani, India, in 1995. He earned a Master of Science degree with a concentration in industrial engineering at Binghamton University, Binghamton, NY, in 1997. The requirements for the degree of Doctor of Philosophy (finance) were completed during the summer of 2001 at the University of Florida.

Kasturi and his wife, Prachi, currently reside in Cleveland, Ohio, where Mr. Rangan is an assistant professor in the department of banking and finance at Case Western Reserve University.

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Mark J. Flannery, Chairman
BankAmerica Eminent Scholar of Finance

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Michael D. Ryngaert
Professor of Finance, Insurance and Real Estate

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Joel F. Houston
Associate Professor of Finance, Insurance and Real Estate

I certify that I have read this study and that in my opinion it conforms to the acceptable standards of scholarly presentation and is fully adequate, in scope and quality, as a dissertation for the degree of Doctor of Philosophy.

Chunrong Ai
Associate Professor of Economics

This dissertation was submitted to the Graduate Faculty of the Department of Finance, Insurance and Real Estate in the College of Business Administration and to the Graduate School and was accepted as partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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Dean, Graduate School